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MANAGE YOUR SUPPLY CHAIN "IN RHYTHM"

DISTRIBUTION INTENSIVE SOLUTION GUIDE

i2 Technologies

The Intelligent Solution for Global Supply Chain Management

The Intelligent Solution.

Distribution Intensive Solution Guide

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RHYTHM®

i2 Technologies

Rhythm logo: i2 Technologies provides intelligent solutions for global supply chain planning and scheduling. It simultaneously considers all constraints. The graphic shows a customer handling all the constraints simultaneously to obtain significant business results. The constraints are: Due Date Planning, Throughput, Operating Expenses, Inventory, and Lead Time. Decisions are made using global rather than local criteria, although global information is filtered and combined with local information.

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1. Introduction

Today's markets demand product variety and quality, with responsive customer service, and all at a price that continues to squeeze business margins. However, these competitive pressures have magnified how traditional manufacturing and distribution infrastructures are unable to support this rapid market change. As a result, new approaches and initiatives have been introduced to streamline operations to ensure competitiveness. Manufacturing has adopted Just-In-Time (JIT) and Theory Of Constraints (TOC) techniques, while distribution has initiated programs such as Quick Response (QR) and Efficient Consumer Response (ECR). All these actions are intended to reduce the costs associated with the timely response to uncertainty in customer demand.

In the past, every business involved in the supply chain that services the consumer would view themselves as a separate entity. They would hedge against the fluctuations in demand by maintaining inventories and safety stocks. But the consumer market is fragmenting into groups seeking greater product options. Therefore, product lines have expanded, greatly increasing the carrying costs for this inventory and safety stock. Sustaining this kind of investment reduces company profits. Therefore, manufacturers and distributors throughout the supply chain are trying to maximize inventory turns and are demanding quicker responses to raw material and product deliveries. As a result, the separation between trading partners (from the customers to suppliers) is shrinking or has become non-existent.

Companies trying to maintain or increase their market position are standing back and viewing the supply chain as a complete "domain of control". They are rethinking their processes within this supply chain with a critical eye on eliminating non-value-adding activities and determining innovative ways in which to optimize the value-adding operations. The goal is to provide a continuous flow of goods from raw materials to end product consumption. i2 Technologies provides a set of comprehensive solutions that can satisfy the complex requirements of the supply chain and assist companies in achieving these ends.

2. The Planning Funnel

Traditional Planning

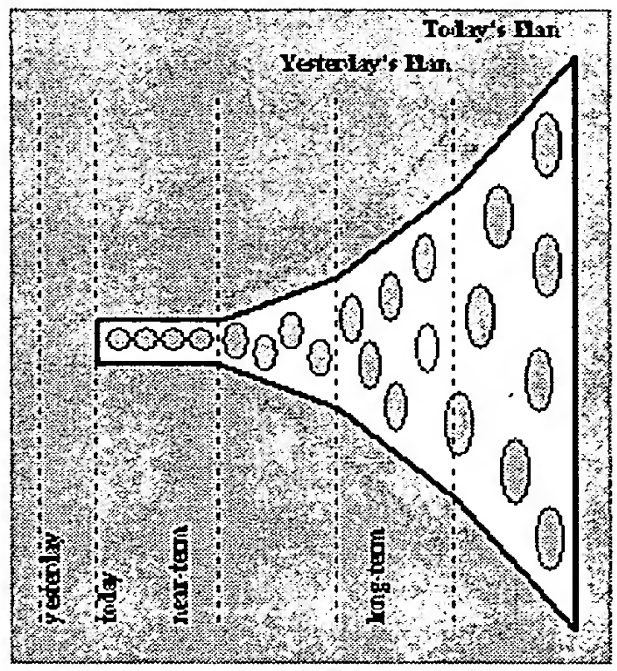
Today's traditional planning processes are typically divided along a number of dimensions. There is a time dimension that stretches from a near-term horizon measured in hours and days, to a long-term horizon that is depicted in terms of months, quarters, and/or years. Another dimension is a division for the type of resource being planned. In these instances, systems are broken into parts to calculate and determine the plan's material, capacity, and logistics needs, along with the demand volume that drives it. The last dimension is functional, and is closely tied to the other dimensions. Functional divisions result in systems that are computing the resource needs to ever-increasing levels of granularity. Aggregate material levels for product families are driven down to purchase requirements for raw materials. Long-term capacity requirements converge on constrained capacity loads, scheduled and sequenced to the hour. Transportation loads are determined and scheduled as the plan is refined to its near-term form.

It is wasteful, however, to ignore near-term detailed plans when making longer term plans. Near-term planning decisions may have important effects on both the near-term and longer-term plans. To illustrate this point, machine break-downs (this is an unplanned event, but some down time can be scheduled and planned) cause delays in the long-term plans, which change the priorities of other near-term jobs. The interrelationships of the resources of all plans are apparent and must be propagated both upstream and downstream within the horizon. The effects of these changes are only visible if the complete plan is integrated. Therefore, integration of all planning functions is necessary to provide a workable solution.

i2's Vision

As shown in the figure, i2's vision is a plan that can vary in detail with the horizon. Integration is achieved by working on only one plan that covers all dimensions of the planning problem. When activity first enters the planning funnel, it is planned very coarsely at an aggregate level. What actually occurs on dates far into the future may vary quite a bit from the original plan. As the funnel moves forward (time passes), the plan is refined, narrowing how much it varies from what actually occurs. Eventually, the plan reaches the near-term horizon (the neck of the funnel) where timing is in great detail. This section of the plan accurately reflects what is expected to happen.

Figure 2-1: Planning Funnel



Distribution Intensive Planning

i2 provides a supply chain planning and management capability for manufacturing and distribution intensive businesses. This capability covers a functional footprint of the full planning funnel, from Strategic Supply Chain Design to Demand Management to Supply Chain Monitoring and Control.

Figure 2-2: Distribution Intensive Planning Funnel

Overview of Solution for CPG

The overall planning horizon is divided into five parts based on the decisions and activities that take place within each one. These smaller time horizons can also be viewed in terms of addressing strategic, tactical, or operational considerations.

Strategic Planning

Strategic activities look the farthest into the future, typically one month to one or more years out. As a result, they are burdened with the fewest number of constraints. There is a long time before actual execution has to occur, so long lead time activities can take place. The accuracy of the forecast for future demand is also at its worst. Within strategic planning are activities and decisions oriented around supply chain design and constrainte-based sales and operations planning.

Supply Chain Design

Supply Chain Design is focused one or more years out. The goal of Supply Chain Design is to design the supply chain network that will best achieve the company's goals based on the best estimates of what future demand will be.

Constraint-based Sales and Operations Planning

Constraint-based Sales and Operations Planning spas the range of one to twelve months from the point of execution. More constraints come into play since there is less time to react. The accuracy of the demand forecast is also increasing. For long lead time products, there may be actual orders to work with in addition to the forecast. Beginning with this phase, and continuing through to the point of execution, the planners' efforts are largely focused to reconciling differencs between the view of demand that was prevalent at the preceding step from the view of demand that is in place now.

The goal of Constraint-based Sales and Operations Planning is to reconcile differences between the plan in the previous phase and what has actually happened so far in the optimal way.

Tactical Planning

As the point of execution continues t approach, the planning becomes much more granular, and more factors have to be considered. The plan becomes even more constrained since there is less and less time to react. At this point, the planners are one day to four weeks away from execution. Accuracy of the forecast for future demand is continuing to increase, with more customer orders that nust be dealt with satisfactorily. Within Tactical Planning are activities and decisions oriented around Constraint-based Planning and Constraint-based Scheduling.

Constraint-based Planning

Constraint-based planning is focused one to four weeks out. Commitment of production resources and commitments to suppliers occur, further limiting the planners' options. Future demand is coming much more clearly into focus. However, it is highly unlikely that it is exactly the same as what was predicted in the previous phase, let alone what was used as the basis for Supply Chain Design.

The key goal of Constraint-based Planning is to satisfy the importnat customers as well as possible given the existence of operational constraints.

Constraint-based Scheduling

Constraint-based Scheduling is limited to one to seven days away from the point of execution. The level of granularity is at its finest. Individual pieces of equipment are being committed to production and distribution of the product.

The view is as good as it is going to get prior to actually producing the product. It may even consist entirely of customer orders.

The primary goal of this phase is to produce the most optimal and feasible plan as possible for the use of each piece of equipment in the supply chain.

Operational Planning

This phase is focused on the here and now, typically looking out no more than 48 hours into the future. It consists of the execution of the plans derived in the previous phase.

Execution

The goal here is to make the plan happen by activating all of the supply chain resources in the prescribed manner and address obstacles. Any discrepancies between what was p[lanned and what was actually achieved are passed back to the preceding phases where more flexibility exists to address them.

3. Product Descriptions

Product / Function Relationship

Each of several products supports one or more of the functional aspects of the planning funnel. Integration of the products, as listed across the top of the following table, in conjunction with an ERP solution, provides a closed loop process. This process results in improved performance under both a sequential approach and a concurrent approach:

- Vertically from planning through execution
- Horizontally across all supply chain activities

The table lists each function in the distribution intensive planning solution in order of occurrence over the planning time horizon. Each check mark indicates the products that apply to the particular functionality.

Function / Product	Advanced Scheduler	Allocated ATP	Distribution Planner	Essbase	Factory Planner	Forecast Planner	Freight Management	Freight Optimizer	Global Logistics System	Inter-Enterprise Collaborative Planner	Optimal Planner	Supply Chain Planner	Supply Chain Strategist
Strategic Network Rationalization													✓
Demand Management						✓							
Sales and Operations Planning				✓		✓					✓		
Available To Promise		✓								✓			
Inventory Deployment			✓										
Manufacturing Plannning					✓								
Transportation Planning							✓	✓					
Transportation Scheduling							✓	✓					
Manufacturing Scheduling & Sequencing	✓												
Supply Chain Monitoring and Control									✓	✓			
Multi-Enterprise Collaboration						✓				✓			

Product Summary

The following table provides a brief overview of each product and the key benefits of the product. Each product is described in more detail, in alphabetical order, following the table.

Product	Description	Key Benefit(s)
Advanced Scheduler	A near-term finite scheduling tool that considers all constraints and their interactions in detail.	Offers a detailed execution of a plan proposed either by Rhythm Factory Planner or MRP. It is sensitive to the current shop floor status and considers sequence-dependent set-up times, batching constraints, material availability, transportation times between resources, and other constraints.
Allocated ATP (Available-to-Promise)	Allocated ATP is part of Rhythm's Demand Management functionality that provides the capabilities companies need to allocate product, make immediate and reliable delivery promises, and then to monitor those promises against the company's actual order fulfillment.	Rhythm's ATP functionality offers benefits over traditional ATP mechanisms because it considers the entire demand/fulfillment process in real time.
Distribution Planner	Develops and maintains a plan for the deployment of inventory within a distribution network. It also identifies the optimal distribution network to use.	Improves Return on Assets (ROA), Customer Service and Satisfaction, Delivery Performance, Profit Contribution, and Responsiveness (Order Lead Time).
Factory Planner	A factory planning tool that uses a managing technique that simultaneously anticipates and accounts for multiple and dynamic constraints in a factory setting.	Creates feasible plans that reflect manufacturing conditions in order to meet manufacturing goals: improving due-date performance, cutting lead times, improving through-put, and reducing inventory and operating expenses.
Forecast Planner	Forecasting and Demand planning decision support system.	The forecast capability helps to better forecast and plan sales and inventory cycles as well as analyze and evaluate forecast performance.
Freight Management	A fully integrated freight management system that improves the speed, economy, and efficiency of the transportation function across an entire enterprise or multiple enterprises.	A feasible, cost efficient, and service effective plan and available-to-promise capability that improves cost reduction, customer service, and increases control
Freight Optimizer	A dynamic transportation routing, scheduling, and planning tool that works in conjunction with Freight Management.	Delivery commitments which leverage present carrier schedules and costs while reducing costs and improving efficiency.

Product	Description	Key Benefit(s)
Global Logistics System	A generic decision support system to facilitate the management of any supply network.	Improved customer service, reduced inventories and logistics costs coupled with better performance from service providers.
Inter-Enterprise Collaborative Planning	A tool that provides management and optimization of inter-domain and inter-enterprise supply chains. It provides the infrastructure and framework for multi-dimensional supply chains.	Improves levels of total delivered cost, customer service, and value.
On-Line Analysis Processing (OLAP)	OLAP tools enable a wide range of planning and analysis applications: sales and operations planning, forecasting, and market analysis.	The tools can accept transaction input, relational database information acting as a data warehouse repository, and spreadsheets which in many cases are the primary source for business projections.
Optimal Planner	Decision support tool that improves manufacturing and distribution operations planning.	Improved customer service and asset utilization with lower costs.
Supply Chain Planner	The Supply Chain Planner is an integrated decision support system for global supply chain management	Addresses the principle business drivers of Return on Assets, Delivery Performance, Profit Contribution, and Responsiveness (Order Lead Time).
Supply Chain Strategist	An analysis and modeling tool that provides managers with insight into the cost and service trade offs across the supply chain.	Provides flexible, efficient, and effective supply chain integration with service improvements and cost reductions Develops strategic and tactical plans while maximizing the total value added through the supply chain.

Advanced Scheduler

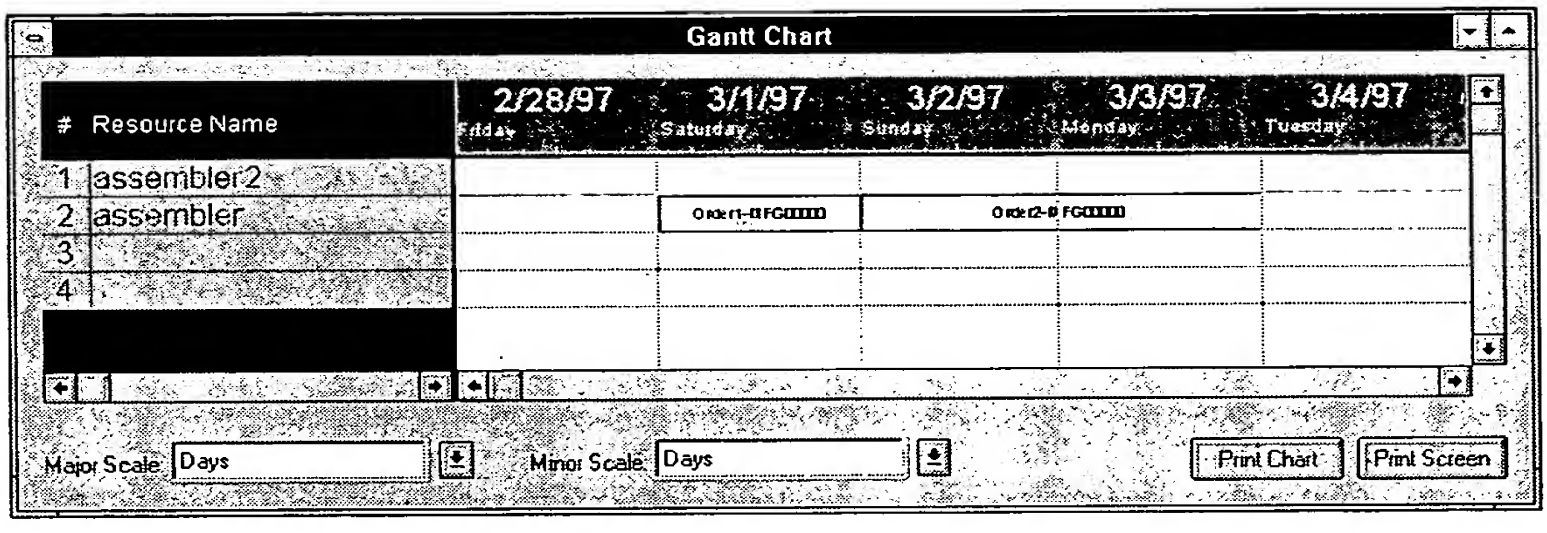
Rhythm Advanced Scheduler is a near-term finite scheduling tool that considers all constraints and their interactions in detail. By definition, scheduling focuses upon the short-term dynamics of the manufacturing plan by considering the minute-to-minute or task-by-task details and recommends solutions to remain synchronized with the manufacturing plan. The output of Advance Scheduler is a material and capacity-constrained dispatch list that will directly instruct an operator on what to run next at each resource. This dispatch list adheres to the manufacturing plan in order to achieve the stated business objectives, which may include minimizing work-in-process inventories, reducing setups on constrained resources, or maximizing delivery date performance.

The scope of Advanced Scheduler deals with the detailed execution of a plan proposed either by Rhythm Factory Planner or MRP. It is sensitive to the current shop floor status and considers sequence-dependent set-up times, batching constraints, material availability, transportation times between resources, and other constraints. Depending upon the dynamics of the shop-floor, Advanced Scheduler can be updated with machine and work-in-process status as frequently as desired, such that in the event of machine downtimes or quality problems, etc., you can evaluate alternative schedules by performing "what-if" simulations. Advanced Scheduler is equipped with both a Gantt Chart as well as a list-based user interface which enables you to interactively examine the current sequence of tasks at each resource. You can interactively change the task sequence by moving them to an earlier or later time period using drag-and-drop technology. All changes are constantly monitored by the system to account for precedence or resource availability constraints, and Rhythm warns you when they are violated.

Gantt Chart

The Gantt chart in Advanced Scheduler graphically displays the tasks loaded on the resources and allows you to re-sequence via drag-and-drop actions.

Figure 3-1: Gantt Chart



Interactive Scheduling

One of Advanced Scheduler's powerful features is the Interactive Scheduler window that combines an automated and interactive approach to scheduler generation. This allows you to interactively modify and improve upon a schedule that is initially proposed by the system, especially in instances where events on the shop floor are constantly changing and too dynamic to model.

User-Defined Scheduling Horizon

Depending upon the dynamics of the shop floor, Advanced Scheduler allows you to determine the appropriate time horizon to perform the detailed scheduling or sequencing activities. Upon determining the desired sequence of orders at each resource, the schedule can be "frozen" over a user-defined time period.

User-Defined Levels of Modeling Detail

Factory Planner allows you to plan at aggregate levels while allowing the Advanced Scheduler to assign orders at individual resources. An example of this capability is the use of pooled resources such as operators, the Advanced Scheduler can generate a crewing report that specifies resources at each location and the assignment of operators to machines required to complete the tasks. This flexibility allows multiple users to view the operating plan at varying levels of granularity and domains that are appropriate to each function. More importantly, the integration with Factory Planner allows the impact of changes at Tower levels to be propagated globally throughout the planning domain.

Sequence-Dependent Set-ups

Some manufacturing environments may require orders or tasks to be executed in a given sequence to meet resource utilization objectives. Advanced Scheduler provides you the ability to model complex sequencing rules taking into account all precedence constraints defined via a set-up matrix.

Sample Functionality

- Supports "rollover" periods when tasks or orders transition between shifts.
- Ability to split and join orders or operations to run on parallel machines.
- All screens and field layouts are fully customizable by the end user.
- Supports scheduling of interruptible or non-interruptible (continuous) operations.
- Generates a detailed sequence automatically or interactively with instant propagation of changes to the rest of the schedule.
- Intuitive graphical user interface with Gantt chart or list-based scheduling.
- Support for automated sequencing logic including (FIFO) first-in-first-out, (SRPF) shortest-remaining process time-first, minimum setup, batching, and aggregate resource scheduling.
- Expedite orders from scheduled operations to override planned start times.
- "What-if" simulation of factory operations based upon demand, resource, or event criteria
- Supports interactive drag-and-drop re-sequencing

Allocated ATP (Available-To-Promise)

Every manufacturer and distributor—regardless of their industry focus—faces the same problem: quickly determining customer delivery dates that can be met reliably. Today, a company's *very competitiveness* is often based upon its ability to make promises to customers quickly—and then deliver on those promises accurately.

The Rhythm Demand Management Solution

Rhythm's Demand Management solution provides companies, whether they are large and complex corporations with many locations or a single plant trying to coordinate its production and logistics, with the ability to confidently make customer delivery promises. Rhythm can provide reliable due dates because it encompasses the *complete* demand/fulfillment cycle—from the sourcing and procurement of materials through manufacturing, transportation, and distribution to customers.

Rhythm begins by generating an accurate production plan that recognizes constraints. Then Rhythm's Demand Management functionality—including material allocation (MA), Order promising (ATP/PTP), delivery date monitoring (DDM) capabilities—enable the company to provide and manage reliable delivery dates, improving due-date performance and customer service.

A Feasible, Constraint-Based Production Plan

The first step in providing the capability to establish realistic delivery dates for customer orders is to determine what can be produced. Unlike traditional planning systems, Rhythm simultaneously generates plans based on the constantly changing dynamics of demand, material, and capacity—considering all constraints that will limit product flow throughout the supply chain. The result is a feasible, constraint-based plan that accurately reflects the expected output of the supply chain. This accurate plan can then be used to establish confident order promises.

Rhythm's Demand Management Functionality

Rhythm's Demand Management functionality provides all the capabilities you and your company need to allocate product, make immediate and reliable delivery promises, and then monitor those promises against the company's actual order fulfillment to identify opportunities for improved customer service.

- *Material Allocation:* Allocation is the process used to distribute material which is in short supply (source: APICS Dictionary; 8th Edition). Traditional ATP mechanisms establish delivery dates on a first-come, first-serve basis, which severely limits a company's ability to improve customer service and profitability.

By intelligently allocating product to specific market categories—a functionality that is unique to the Rhythm solution—companies can better serve high-priority customers, thus improving responsiveness, and high-margin orders, thus increasing the company's profitability.

- *Order Promising:* After the supply plan has been effectively allocated, accurate delivery date promising and quotation is possible. Rhythm's modeling capabilities allow companies to define all elements that determine total lead time when establishing customer order delivery dates. This includes the dynamic nature of wait time in production, detailed identification of logistics steps, and differing transportation modes—all leading to more accurate delivery commitments and improved customer service.

  Rhythm provides a complete solution for order promising, enabling companies to perform the delivery date promising function in either a material-oriented (ATP) or capacity-oriented (PTP) fashion. This flexibility allows companies to choose the manner, in whatever combination, that best meets their needs.

  ATP (Available-to-Promise): ATP is the uncommitted portion of a company's inventory and planned production maintained in the Master Schedule to support customer order promising (source: APICS Dictionary; 8th Edition). Rhythm's ATP functionality offers benefits over traditional ATP mechanisms because it considers the entire demand/fulfillment process in real time.

  In addition, Rhythm offers flexible options for you to meet customer needs by providing visibility into additional sourcing options, the use of alternate materials and/or resources, and the use of different transportation modes. Using these capabilities, the sales function can negotiate fulfillment options that meet customer needs and maintain the company's production schedule.

Rhythm Demand Management Function/Benefit Analysis

Function	*Benefit*
Extensive modeling capability	Enables a company to model its entire organization so Rhythm can provide much more accurate delivery commitments than traditional order promising systems that rely on fixed lead times
A feasible, constraint-based plan	Provides realistic input for confident order promising
Unique material allocation capability	Allows companies to better serve higher-priority customers, thus improving responsiveness, and high-margin orders, thus increasing profitability
Available-to-Promise (ATP)	Allows companies in a MTO capability manufacturing environment to reliably quote delivery dates
Alternate sourcing, parts, resources, and routings	Enables companies to intelligently consider various options for fulfilling customer demand while maintaining their production schedule
Reallocation rules	Allows companies to reassign allocated materials to best meet their customer service and profitability goals

Features and Benefits of Rhythm Demand Management

Accurate delivery date quoting has become critical to competing in today's marketplace; in fact, it can become a competitive advantage for companies who excel at this function. Rhythm's order promising capabilities significantly improve a company's ability to make delivery commitments with confidence.

Extensive Modeling Capability

One of the ways Rhythm enables real-time, reliable order promising is through its extensive modeling capability, which allows a company to model its entire organization—including production sites, distribution sites, market/sales channels, products and product families, production resources, logistics resources, bills-of-materials, routings, and suppliers. With some or all of these elements modeled to the level of detail desired, Rhythm can provide much more accurate delivery commitments than traditional order promising mechanisms.

Determining Available Supply

To accurately determine an ATP quantity and delivery date, three pieces of information are needed:

- The current inventory on-hand
- Customer orders that have been provided a promised delivery date
- The company's current and planned supply position—a time-phased inventory replenishment plan that is the result of a company's planning system. In traditional MRP II systems, this is the result of Master Scheduling and Material Requirements Planning and is called the material plan.

However, traditional planning solutions cannot effectively produce the third piece of information because they fragment the planning function into several sequential steps, requiring long run times and resulting in material and capacity resource plans that lack coordination. Thus, the input these traditional systems use to compute ATP is invalid, making their ATP functionality highly questionable.

Rhythm offers a breakthrough solution to the planning problem that, in turn, makes its ATP capabilities significantly more effective. Using its comprehensive supply chain model, Rhythm considers all factors—including constrained resources—throughout the supply chain concurrently, resulting in an accurate, feasible, and coordinated plan.

Utilizes the Supply Chain Model

The lead time dynamics within the supply chain cannot be accurately represented by fixed and standard lead times. Common sense dictates that actual lead times will vary with load, priorities, resource availability, production mix, and other factors. Rhythm solves this problem by utilizing a company's supply chain

model, which accurately determines the supply chain's dynamics. The result is realistic plans that pin-point a company's supply availability.

Rhythm's accurate supply plan enables companies to promise delivery date with reliability. This increases the customer confidence in the delivery dates being provided and also improves customer service—resulting in a strong competitive advantage.

Concurrent Planning

Material and capacity requirements and the company's ability to meet demand are intimately interrelated. If capacity changes, this will affect both the need and timing of material and the company's ability to meet demand. If material availability changes, capacity requirements are affected along with the company's ability to meet demand. Any one of these factors is dependent on and will affect the other two.

Rhythm's planning process concurrently plans these variables together in a single pass. As variables change, the effects are propagated upstream and downstream within the company's supply chain immediately. This innovative approach ensures that all resources are planned and scheduled in a coordinated fashion.

Constraint-Based Planning

Traditional planning systems operate on an infinite resource assumption. Both material and capacity resources are limited. Rhythm recognizes this limitation by considering the supply chain's constraints. Then Rhythm subordinates the entire plan to the constraint's limitation to ensure the coordinated and maximum flow of product through the supply chain.

By identifying and managing a system's constraints, Rhythm provides a feasible plan that does not over-commit the supply chain's capabilities, which is crucial for accurate delivery date promising.

Material Allocation

In some industries, specific materials are in short supply, resulting in constrained production that does not satisfy market demand. For example, the electronics industry typically has limited supplies of high-speed Megahertz chips, which constrains its output. These material constraints are recognized by Rhythm as it calculates a feasible plan.

Once the plan is generated, Rhythm's allocation capability enables you to distribute this constrained material supply in the most effective, equitable, and profitable way. By assigning quantities of items to specific sales channel classifications, Rhythm's allocation capability supports your company's customer service goals.

Allocation Techniques

You may choose to allocate portions of its production in a variety of ways.

- ***Hierarchically*** - In many instances, companies organize their market views hierarchically. Using geography as an example, a percentage of worldwide supply is assigned to each area. The geographic areas then assign their portion to each country, then to each region, and so on. With this hierarchical structure, allocations can be automatically distributed, proportioned based on their "committed sales figures"—or the portion of the forecast that sales will commit to—from the company's sales channel model.
- ***By Pricing Categories*** - Allocations can also be made according to pricing categories, so that percentage portions of the available supply are priced differently due to the demand patterns of the marketplace. Last-minute orders are charged premium prices for on-time delivery. By freeing companies from the traditional ATP "first-come, first-serve" mechanism, available production can be "reserved" for emergency orders, providing an opportunity to increase company profits. In this example, the customer order's classification would be the number of days lead time the order allows for delivery.
- ***By Customer*** - Allocation can even be specifically assigned to individual customers. This enables your company to enact focused customer service initiatives for higher-priority customers to ensure that they are always guaranteed certain service levels. This eliminates the risk of having available supply consumed by lower-priority customers—resulting in the inability to supply special customers—or having to break delivery date promises for some customers to deliver to higher-priority customers. Either alternative negatively affects overall customer service.

Rhythm presents the results of this automatic distribution for management review and adjustment. Distribution could also occur manually and then be aggregated up and/or dis-aggregated down through the sales channels.

Rhythm's allocation support allows for the distribution of available production quantities for any market segment defined within the sales channel model. These categories help control how commitments are made—ensuring that service level policies and sales segment commitments are honored and providing greater flexibility than the FCFS restrictions of traditional ATP approaches.

Customer Order Delivery Date Promising via ATP

As orders come into a company through its order promising function, the people receiving the customer orders review the available-to-promise product levels in that customer's allocation category to determine if the customer's order can be fulfilled—if there is enough product available to complete the order. Since Rhythm constantly monitors the ATP inventory levels, the sales department can be confident in its ability to promise valid delivery dates based on the information they can access.

When orders are confirmed, they consume ATP product in that allocation category, resulting in updated inventory levels for future customer orders. This ensures that over-commitment of product does not occur. ATP functionality offers companies the ability to quickly make delivery promises they can keep, increasing responsiveness and reliability.

An example of the ATP process might involve a company that has allocated 100 units of a product to its Eastern sales region. Currently, only 40 units remain; the other 60 have already been sold to other Eastern region sales customers. When a customer from that region calls to place an order, the order taker would determine if the customer's order can be fulfilled with the Eastern region's ATP inventory. If the customer would like 20 units by week three, the order taker could immediately confirm the order since ATP is sufficient. If the customer accepts, the confirmed order would then consume a portion of ATP inventory, leaving the Eastern sales region with an ATP of 20 units.

If the customer wanted to order 60 units, the order would exceed the Eastern sales region's ATP. The order taker must then consider other options to meet the customer's demand. As a first alternative, the order taker could offer to deliver 40 units in week two, 10 units in week four, and the final 10 units in week five. This alternative may be acceptable, as customers often pad their requirements and dates hoping to get at least some of what they have requested. This padding is a direct result of the customer's lack of confidence in quoted due dates.

If this alternative is acceptable to the customer, it generates tremendous company benefits. Through visibility of the timing of ATP inventory to the sales department, the order taker can offer alternatives to the customers' original request—some of which may be satisfactory in meeting the customer's requirements. This flexibility allows sales to manage the demand pattern to fit the company's planned production. Without this visibility, sales often will blindly accept orders, putting pressure on manufacturing to meet the dates. To do this, manufacturing is forced to expedite orders and increase capacities—through overtime, for example—which reduces the company's profit margins.

Using Rhythm's real-time ATP capability, companies can buffer demand uncertainties by negotiating with customers to make due-date commitments that meet customer needs as closely as possible and do not create the need for expediting orders. Rather than carry larger safety stocks to absorb these demand patterns, visibility provides companies with the ability to "manage" delivery dates so, as much as possible, they conform to the company's production schedule.

ATP Alternatives for Meeting Requested Delivery Dates

Visibility into the current ATP position is the foundation for order fulfillment options. This coupled with the capability to allocate portions of supply to specific market segments provide companies with the means to improve their customer service and enhance their competitive position in the market. With Rhythm, companies can investigate multiple options to meet customer demand, while maximizing profitability.

Alternative Sourcing: When orders are processed, there is a primary source from which the order is to be fulfilled. Generally, this site reflects the company's most cost-effective source for product delivery to this customer. Often the sites are arranged geographically for multi-site enterprises.

If the complete order quantity cannot be delivered on the customer's original request date, the sales department—through ATP visibility—can suggest a split shipment alternative that will deliver portions of the requested quantity on multiple delivery dates. This option may satisfy some customers; however, other customers will not accept partial shipments.

When all efforts are exhausted at one order-taking site, visibility of ATP at alternate sites can help service the customer. For companies with multiple supply sites, the order can be fulfilled from another site. Rhythm provides delivery date options, and their associated costs, for supply coming from different sites. If the requested quantity is available on the requested delivery date at another site, then the alternate supply source is an option for that customer.

Typically, alternate sources will increase transportation costs. Depending on the order/customer circumstances, these additional charges could be passed on to the customer or absorbed by the company.

Companies may not want to allow sites to claim available inventory of a different supply site within the enterprise. In those cases, Rhythm will place a "pending" request against the available inventory. Final confirmation of the pending request could be based on a priority hierarchy—such as on-site orders receive the highest priority, followed by "pending" requests from other sites, with quotations as the lowest priority.

If the customer will allow deliveries from multiple sites but requires that the complete order quantity be delivered on the requested date, then alternate sourcing can be used to satisfy the primary site's shortage. Order fulfillment can be split among alternate sourcing sites to meet the delivery request date.

Rhythm's visibility into ATP across the complete enterprise provides order fulfillment options that will improve customer service and due date performance.

Summary

In today's fast-paced and competitive environment, all companies are under increased pressure to meet customer delivery requests. Providing unreliable delivery dates is often a company's downfall. To keep customers, companies must quickly and accurately commit to the customer order—in quality, volume, price, and timing—to maintain satisfied customers and fuel company growth.

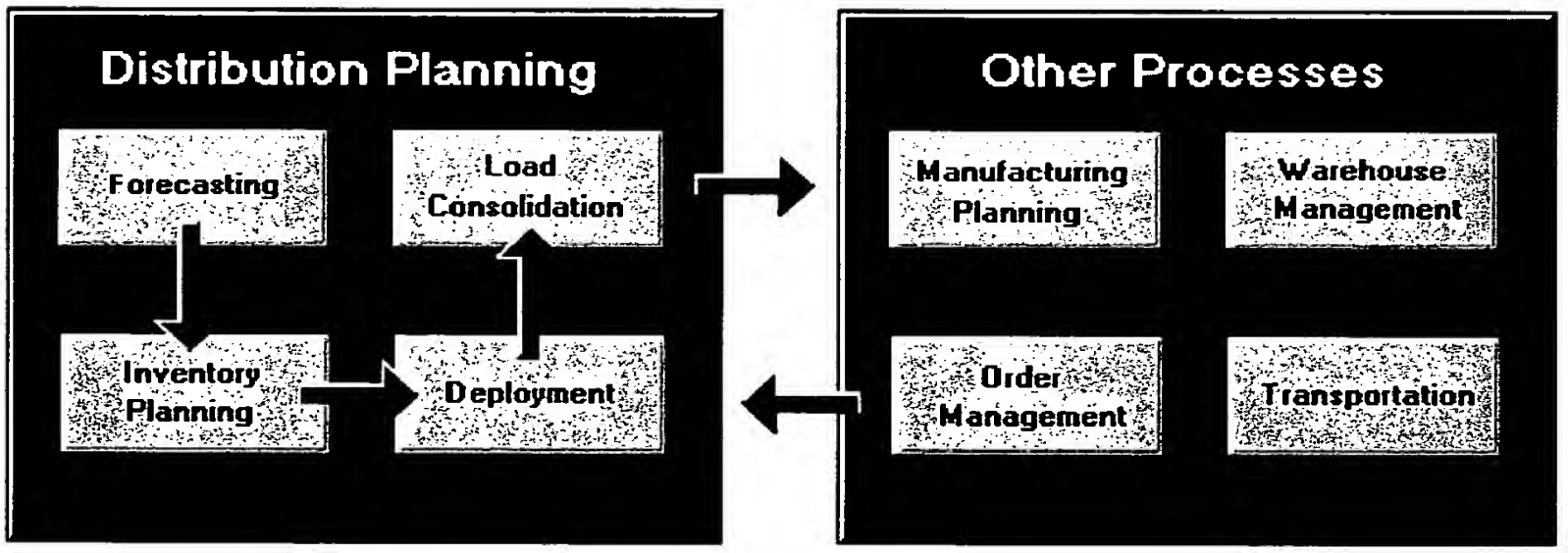
To provide reliable delivery dates, the order taker must have complete visibility into all elements of the supply chain. It is no longer sufficient for customer order takers to just enter the order, hoping that the company can find a way to meet the delivery date. Today's business systems must be able to analyze its supply chain capability *before* committing to the customer. These business systems must understand and accommodate unique customer requirements—essentially knowing each customer and the capability of the enterprise—in order to establish delivery dates with confidence. Rhythm, with its ATP functional capabilities, provides such a business system.

Distribution Planner

What is Distribution Planning?

Historically, distribution planning has been a time phased approach to planning that projects anticipated supply chain needs over days, weeks, and months into a planning horizon . It is a complex problem that planners traditionally divide into its smallest parts and address as individual processes. Planners then concern themselves with supply chain issues like deployment and load consolidation as entirely separate elements. This division of the planning process simplified the problem to the degree that the larger problem was easier to solve one piece at a time, but the inherent complexity of distribution planning as it is applied to the entire supply chain remained. Each piece of the divided solutions is dependent upon the solution of all the other pieces in the plan. The distribution plan becomes modularized and sequential with planners simply linking each solution or module (each individual operation) to the next module in a time consuming sequence. As a result, the traditional system takes a long time to run and changes are difficult to execute effectively.

Figure 3-2: Typical Distribution Planning Process



The i2 approach to Distribution Planning is to provide a completely integrated approach that consolidates the different planning functions and manufacturing concerns within a supply chain. RhythmDP enables the planner to manipulate orders, the allocation of material, warehouse sourcing, and transportation information. RhythmDP then integrates the data with supply chain forecasting information, inventory planning, and deployment and load consolidation. The result is an aggressive, accurate approach to planning and allocation of material that incorporates transportation constraints into the planning process.

Additionally, RhythmDP respects priority differences in the demand from different sources. The demand and supply matching process inherent in the RhythmDP improves the planners ability to promise accurate and reliable delivery dates to customers.

Traditional Supply Chain in a Distribution Planning Environment

In the traditional Distribution Planning environment, planners administer each element of the distribution planning process separately and sequentially in a Distribution Resource Planning (DRP) driven approach:

- Forecasting
- Inventory Planning
- Deployment
- Load Consolidation

Once planners complete the sequential planning process, they use standard interfaces to connect all applicable processes to manufacturing planning, order management, warehouse management, and transportation needs. This approach to distribution planning has no visibility of, and as a result cannot interact with, the factory planning function. Planners make distribution planning decisions on the basis of long to mid-term production schedules in the factories without direct visibility of the factory constraints. The traditional approach, although able to provide some level of data integration and functional integration, does not provide any level of process integration. Each step in the planning process is still modularized and sequential.

The Rhythm Distribution Planning approach provides for total integration of the distribution planning environment outlined above. Planners will increase throughput, reduce inventory, decrease cycle times, and improve customer delivery date performance. Additionally, RhythmDP integrates transportation needs and factory planning processes into the solution for better visibility of the real priorities in the distribution environment. In this new integrated planning environment, planners do not address the different functions as separate elements. Therefore, there are no boundaries. The "plan" is not only for the factory but also for the associated distribution centers and customers. It incorporates inventory and capacity constraints throughout the distribution network whether they exist in the plant or with transportation providers.

Traditional Flow in a Distribution Environment

The traditional flows in the distribution environment are those between plants and Distribution Centers (DCs). The planner does not typically model the flows between the DCs, plants, and customers. Therefore, a planner only creates replenishment and resource plans for plants, locations, and the flows between them. It is impossible to plan resource consumption (transportation) between DCs and customers because customers are not included in the model. Modeling only some of the flows does not provide visibility across the entire distribution

network. In fact, it excludes the level of the supply chain that is the most important: the one that actually generates demand. This exclusion of vital flows is the reason why only summary level data is available to traditional solutions.

Summary level data is any order information from forecasts (or customers) that represents the total demand and not individual quantities from individual customers. Since planners do not include customers in the traditional distribution model, forecast data typically represents summarized quantities. It is impossible for a planner to distinguish which portion of the forecast is attributable to which customer. Although most DRP driven solutions do have access to some customer level order data, this lack of visibility limits the effectiveness of both the deployment and load consolidation processes. The "real-worldliness" of the resulting fair share quantities (deployment process) is still limited by the fact that forecasts represent all customers.

Rhythm SCP allows companies to represent customers and suppliers. The differences offered by Rhythm SCP allow a planner to create a distribution network that deals with real world constraints and demands. In addition to the functionality of the traditional approach, Rhythm SCP offers several other features:

- Customer ship to nodes
- Overflow locations
- Co-packers (contract manufacturers)
- Multiple sources
- Alternate sources
- Alternate modes of transportation
- Assembly requirements
- Representing flows and respecting constraints

Through Rhythm SCP, a planner has access to a real world distribution network that is more dynamic and comprehensive than the traditional approach to planning.

Traditional Types of Locations/Sites Involved

The distribution environment has a number of locations that interact to manufacture and deliver items to the consumer:

- Co-Packer
- Customer Distribution Center
- Distribution Center
- Overflow Warehouses
- Plant
- Plant Warehouse
- Retail Outlets

- Supplier Location

Industries Typically Involved in Distribution Planning

The Consumer Packaged Goods (CPG) industry has traditionally been involved in a distribution centric approach to planning. Due to the types of the products sold by CPG companies and the inherent competition, distribution is a complex and labor intensive problem. Typically, consumers buy CPG industry products directly from stores or catalogs in small quantities several times per year (e.g. groceries). The sales environment is extremely competitive and manufacturers sell items at relatively low prices. Frequently, items are on "sale." The product appeal is not style oriented and brands have a relatively long "half-life" (e.g. computer games, apparel). Distribution has to be fast and flexible to respond to the inherent volatility in the distribution process.

Products sold by CPG companies tend to have many different and varied Stock Keeping Units (SKUs) distinguished only by packaging or size. Additionally, costs associated with marketing, distribution, and transportation usually exceed costs associated with manufacturing and material. Once a planner deploys inventory, it is usually expensive to move it somewhere else. Seasonal issues are important as they relate to demand and there is not much automation within the system. As a result, effective Distribution Planning is important to the CPG industry. A number of industries that resemble CPG are food services, white/brown goods, home electronics, textile and apparel, and pharmaceuticals.

Business Issues Involved in Distribution Planning

In Distribution Planning, customers and manufacturers do not share available planning information. Communication between manufacturers and customers is limited mainly to purchase orders launched by customers, and communication between manufacturers and suppliers is limited mostly to purchase orders launched by the manufacturer. Traditionally, a manufacturer influenced the behavior of the supply chain by managing those facilities which it owned and/or controlled. These facilities include plants, plant warehouses, co-packers, regional DCs, and overflows. Interaction and coordination among entities (supplier-manufacturer-customer) is almost non-existent. Each manufacturer, supplier, and customer derives plans for its nodes as if they existed to the exclusion of any other elements and then fails to share information.

In this segmented distribution planning environment, each entity believes that all other entities are beyond its sphere of influence. Therefore, each entity focuses on shifting cost from its portion of the supply chain instead of cooperating to eliminate cost from the supply chain entirely. This segmented, non-integrated approach limits the maximum achievable effectiveness of the planning process.

Cooperation among entities is the key to eliminating cost from the supply chain. Increased visibility and detail in the supply chain are prerequisites for achieving this cooperation. A manufacturer must expand its view of the supply chain in order to satisfy these prerequisites so that it encompasses all relevant customer

ship to nodes. This results in an atmosphere that has sufficient visibility and detail. Visibility of the supply chain substitutes information for planner estimates. More detail provides a better basis for allocating scarce resources when it is necessary to do so. Additionally, a planner can generate Available to Promise (ATP) quantities at lower, more useful levels. Planners can enhance detail by classifying each customer according to the way it impacts the planning process and understanding why each customer needs to be replenished.

Areas that the Rhythm Product Addresses

RhythmDP provides a new approach to planning. Internal and external pressures in the manufacturing environment are forcing companies to re-evaluate their business strategies in order to serve customers more efficiently. RhythmDP provides each customer with intelligent decision support tools to employ i2 advances in concurrent planning, constraint based management, bi-directional change propagation, speed, multi-enterprise management, and interactive planning. The product provides significant results in key business drivers:

- Return on Assets (ROA)
- Customer Service and Satisfaction
- Delivery Performance
- Profit Contribution
- Responsiveness (Order Lead Time)

RhythmDP addresses many of the limitations inherent in traditional systems and differentiates them from traditional planning solutions. Increased speed in the supply chain provides the ability to avoid information propagation delays that traditionally lead to inventory and capacity buffers. Additionally, RhythmDP supports fast "what-if" simulations of business across the supply chain and manufacturing domains.

Constraint based management provides a "real world" framework to plan. In any multi-site enterprise, the ability to synchronize and facilitate the flow of raw materials and finished goods becomes a key constraining factor. Engineers at i2 designed the RhythmDP architecture to provide the ability to simultaneously plan data, variables, and constraints from all aspects of a company's operations. Additionally, bi-directional propagation allows a planner to plan events and address problems across the entire supply chain. The concurrent planning architecture gives planners the ability to support business process design and redesign to reduce inventory and increase capacity.

RhythmDP is capable of addressing and handling complex distribution networks. It provides distribution models of regional, national, and international supply chains. These models can have inventory deployment policies that negotiate and make automated sourcing and allocation decisions rapidly.

Traditional Planning Process Used in Distribution Planning

Traditional distribution planning solutions provide at least some level of both data integration and functional integration. They are not, however, able to provide any level of process integration. As a result, the traditional solution is incapable of providing the means for achieving seamless bi-directional supply chain plans. Process integration is the key to intelligent planning and scheduling. Within an integrated process there are no separate functions or boundaries. The operational plan incorporates not only the factory model but also the DCs and customers. Additionally, it incorporates inventory and capacity constraints throughout the distribution network whether they exist in the plant or with transportation providers.

The Planning Process consists of iterations of "generate plan" activities interspersed with planner interaction opportunities. RhythmDP derives its initial plan by generating net requirements and offsetting them by one "normal" lead time to the "normal" source of supply. It then considers "real world" issues by respecting the relevant constraints.

Planner Interaction and Authority Domains

In many business organizations, the group responsible for inventory planning differs from the group responsible for load consolidation. Similarly, the group responsible for deploying finished goods differs from the group responsible for master scheduling. The RhythmDP solution must support these divisions of authority.

The need to integrate authority domains severely impacts the way in which a planner can resolve problems. If a planner can control finished goods inventory planning and load consolidation for every item at all locations, then the process of resolving problems is straightforward. However, planners typically have authority over only a subset of the total items and locations within a given supply chain. They must define the problem resolvers they want to use and when in the planning process to execute them. If a planner is responsible for inventory planning but not load consolidation, then the planning process must provide an opportunity to identify and resolve inventory related problems before a second planner applies transportation constraints.

RhythmDP allows planners to configure their respective planning processes with visibility of the changes and constraints in the supply chain. Planners can introduce new changes at any point in the distribution planning process.

Planning Problems in the Distribution Environment

RhythmDP detects problems by comparing each demand's due date to its adjusted due date. When the two dates differ, RhythmDP automatically identifies a problem. If the problem falls within the deployment interval, then RhythmDP classifies it as a customer service problem. If it falls within the planning interval, then it is a supply problem.

Customer Service Problems

Three types of customer service problems relate to orders placed with customers, forecasted orders, and breaking promises for allocated quantities.

Problems with Customer Orders

- Order projected to be delivered late
- Order projected to be delivered short
- Order projected to be delivered late and short

Problems with Forecasts

- Forecast late
- Forecast short
- Forecast late and short

Problems with Allocations (a new plan results in having to allocate less than originally promised)

- Allocation short
- Allocation late
- Allocation late and short

Supply Problems

Three types of supply problems relate to inventory, transportation, and capacity.

Inventory Related Problems (adjusted due date will cause demand to be greater than supply)

- Not enough inventory
- Safety stock violation
- Too much inventory

Transportation Oriented Problems

- Mode not available
- Oversize due to simultaneous delivery dates
- Oversize
- Ship point capacity not available
- Receiving point not available
- Insufficient payload

Capacity Oriented Problems

- Resource underload
- Resource overload
- Cumulative resource overload

Resolving Problems

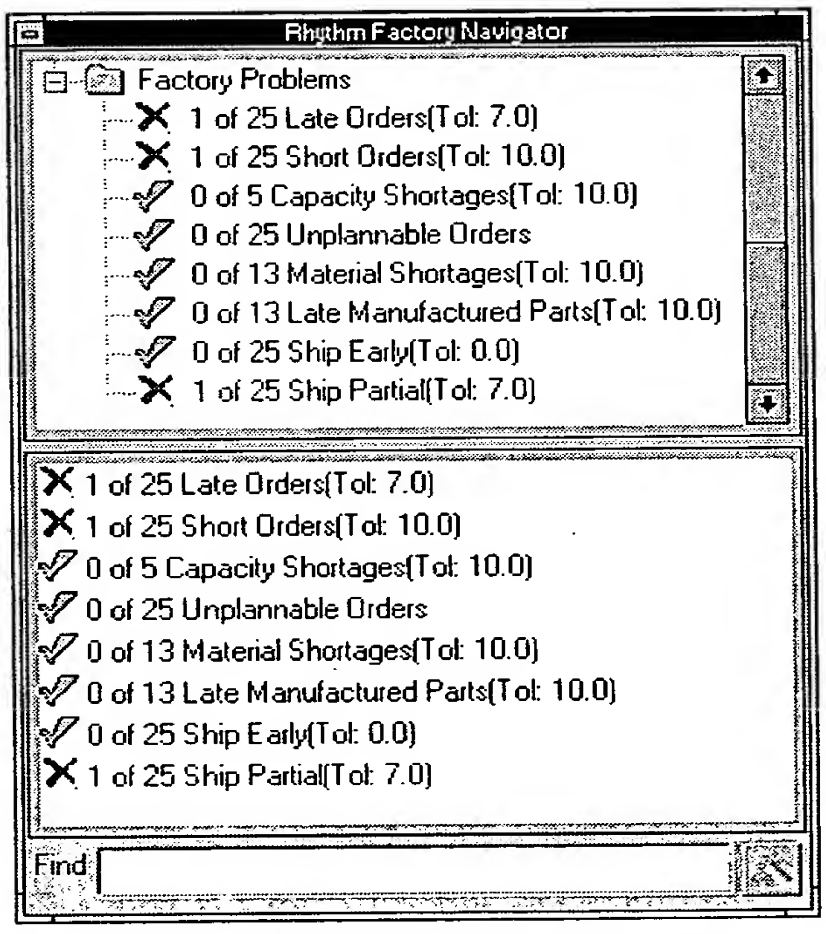
RhythmDP detects problems in the same sequence that planning took place. Given this sequence, you must be able to configure the RhythmDP approach to resolving problems. You specify the sequence in which RhythmDP solves problems, the specific kinds of resolvers that it uses for each problem type, and in what sequence RhythmDP considers them.

The methods RhythmDP uses to resolve problems depends on the type of problem, the cause of the problem, and whether it fell into the deployment or planning interval. Additionally, you should consider relative priority of the customer and the relative priority of the demand type as types of problems. RhythmDP supports the following types of resolvers :

- Adjusting Demand
- Adjusting Inventory
- Adjusting Resources
- Reconfiguring the Supply Chain

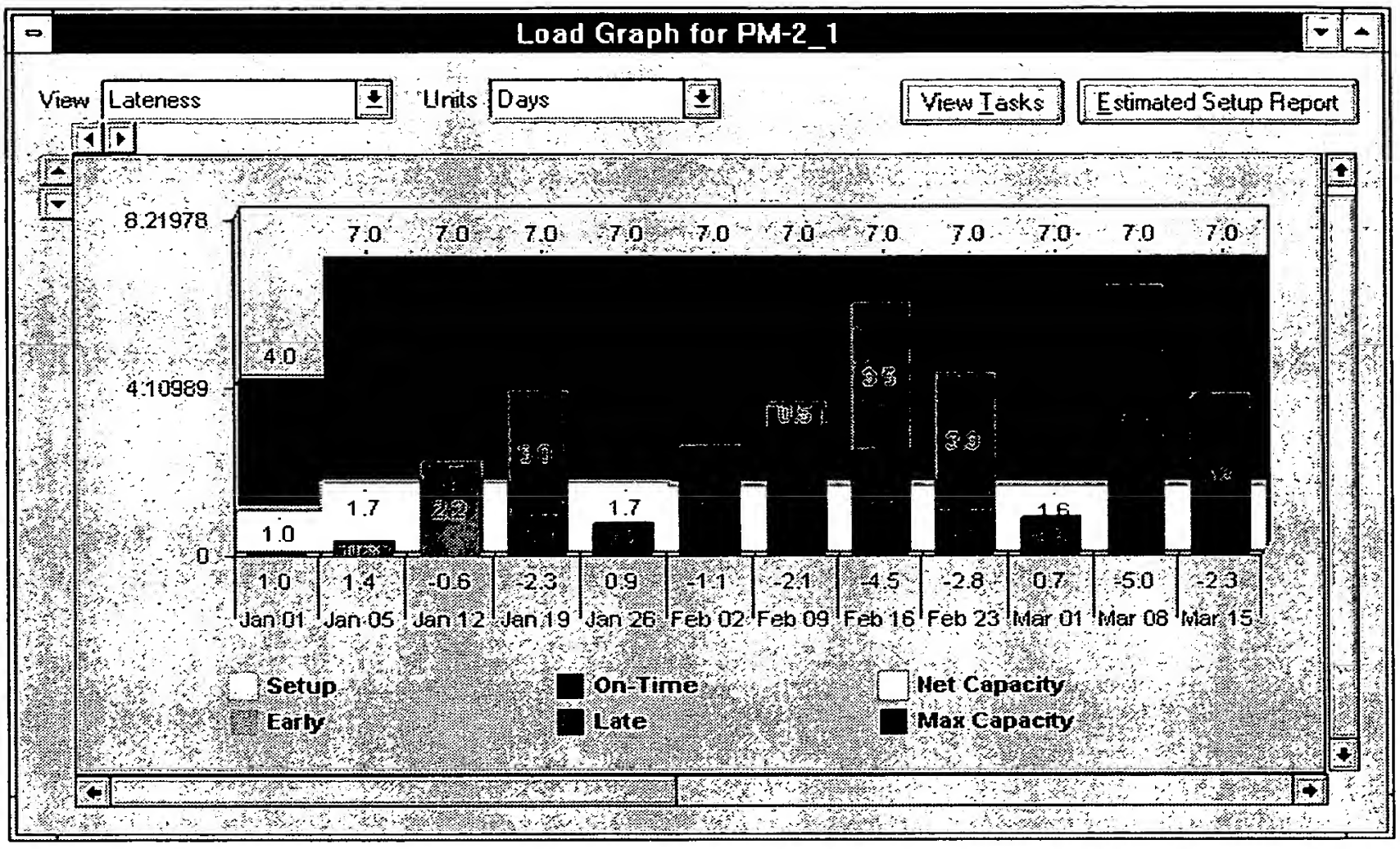
The Problem Window is an interactive mechanism for users to identify and resolve problems quickly without being inundated with large volumes of data.

Figure 3-3: Problem Window



The Load Graph allows users to view loads at individual resources and manipulate them interactively or automatically using Rhythm's load balancing algorithms.

Figure 3-4: Load Graph - Lateness



Factory Planner

Rhythm's Factory Planner product takes a global approach to intelligently optimize the performance of your manufacturing operation. By analyzing what is best for the manufacturing organization as a whole and simultaneously managing multiple and dynamic constraints, Factory Planner develops feasible plans that meet both your customers' delivery requirements and your business objectives.

Factory Planner generates a feasible production plan for a plant or multiple plants, department, work cell, or production line by scheduling backward from the order's due date as well as forward from the current date. It simultaneously considers constraints at key operations to provide the best overall operating plan.

Factory Planner manages in real time, complex manufacturing operations involving large numbers of resources and operational steps, and solves common planning problems found in factories, such as managing complex bills of material, alternate routings, and optimizing machine set-up sequences. The goal of Factory Planner is to produce an intelligent and feasible Master Production Schedule along with the associated set of manufacturing and purchasing recommendations to support that plan, while the Rhythm Advanced Scheduler determines the optimal sequence of operations at each resource.

With its global visibility and constraint management capabilities, Factory Planner creates feasible plans that reflect real-world manufacturing conditions in order to meet manufacturing goals such as improving due-date performance, cutting lead times, improving through-put, and reducing inventory and operating expenses.

Infinite and Finite Capacity Planning?

Infinite capacity planning is an important step in formulating an optimal, finite capacity plan. Factory infinite capacity plans illustrate the ideal level of resource capacity needed to meet customer demand. In infinite-capacity planning mode, Factory Planner flags the overloaded resources, allowing the user to take corrective measures to meet the delivery date. However, you also have the choice of using Factory Planner's automated load balancing algorithms to create an optimal finite-capacity constrained plan automatically.

Real-time Due-Date Quoting Capability

Rhythm's planning engine is extremely fast, generating plans in minutes compared to hours in traditional MRP systems. Its architecture supports a highly flexible modeling capability allowing you to model their factory at a detailed level. Based upon the current manufacturing profile of the factory, Factory Planner allows you to quote accurate and reliable delivery dates to your customers in seconds or determine the status of a customer order in real-time.

Does Factory Planner Fit Into My Environment?

Factory Planner is a proven planning solution that supports assemble-order, configure-to-order, make-to-order, make-to-forecast, build-to-stock, and hybrid environments. It also supports discrete, batch-process, and rate-based environments in all major industries including metals, hi-tech, automotive, consumer packaged goods, industrial products, pharmaceuticals, and aerospace and defense industries.

How does Factory Planning Interface With My Existing Systems?

Factory Planner is a decision-support system that works with MRPII or ERP systems, and transactional databases. Through real-time interfaces to MRPII, Factory Planner uses the data maintained on these transaction systems for intelligent planning and decision support. Factory Planner creates a feasible production plan and schedule in a fraction of the time taken by a traditional MRP system.

Sample Functionality

- Fast planning and re-planning of orders due to demand variability and volatility.
- Warns the user when a plan violates a constraint or user-defined rule.
- Supports for alternate routings and offloading.
- Provides the ability to do multi-plant planning.
- True multi-user planning capabilities.
- Automatically propagates the effects of a planning decision both upstream and downstream.
- Supports traditional planning techniques, such as Kanban, backward scheduling, or forward finite scheduling, or users can create a planning strategy of their own provides a resource calendar that allows you to specify the availability of resources.
- Graphical user interface (GUI) is intuitive to planners.
- Supports both "bucketed" and "bucketless" planning.
- Supports manual override of automated planning algorithms.

Forecast Planner

Rhythm Forecast Planner is a forecasting and demand planning decision support system that can be operated as easily by someone who spends five minutes a week planning as someone who spends hours a day. Rhythm Forecast Planner comes with a wide range of pre-defined forecasting techniques:

- Exponential smoothing
- Moving averages
- Multiple regression
- Fitting straight lines to the data
- Adjusting for effects such as trends and seasonality
- A "PickBest" function that helps you select the best forecasting technique for a demand pattern

In addition, Rhythm Forecast Planner supports all other forecasting methodologies. The powerful forecasting capability helps you better forecast and plan sales and inventory cycles, as well as analyze and evaluate forecast performance by including these features:

- Allows you to develop forecasts based on the impact of factors like promotions, price changes, competitive activities, and product life cycles.
- Provides a powerful allocation capability, so you can update the data in your database with the results of a forecast.
- Allows you to export the data in Rhythm Forecast Planner to other software packages, allowing you to take advantage of their more specific capabilities (such as slide shows, advanced reports, and complicated graphs).

Freight Management

The Rhythm planning process receives several elements as inputs:

- demand (forecasted and customer orders)
- inventory availability
- manufacturing / distribution costs
- manufacturing / distribution constraints

Rhythm then produces a plan recommending manufacturing orders and replenishment.

The Freight Management application supplies Rhythm with detailed transportation cost and constraint information, resulting in a more feasible, cost efficient, and service-effective plan and available-to-promise capability. Because Freight Management is managing the complete execution of transportation processes, it has the ability to provide detailed information on the mean and variability of transportation cost and service performance, as tracked in the transaction system. Freight Management is a fully integrated freight management system that improves the speed, economy, and efficiency of the transportation function across an entire enterprise, or multiple enterprises. Freight Management allows you to perform several functions:

- automatically assign carriers / modes
- consolidate shipments
- send out tenders
- create documentation
- generate invoices

It also handles multiple shipment requests and provides EDI supported track and trace options. Freight Management provides customers with significant benefits including cost reductions, improved customer service, and increased control:

Cost Reductions

- Determine automatically the most appropriate carrier based on least cost, service requirements, carrier performance, or transit time.
- Enable the sales force to factor actual freight charges into sales quotations in order to maintain profit margins.
- Increase accuracy through detailed management of both carrier invoicing and customer billing.
- Eliminate costly and time consuming manual freight audit.
- Manage resource requirements through effective forecast reporting.

Improved Customer Service

- Utilize the latest electronic commerce methodologies for effective communication with carriers.
- Produce required documentation for trading partners.
- Create carrier compliant documentation therefore eliminating the need for customers to invest in carrier specific Freight Management systems.
- Build tailored customer partnerships by designing unique solutions that meet the expectations of each customer.
- Build and maintain customer profiles, keeping track of services, conditions, and options for each.
- Build and maintain customer specific tariffs and / or surcharge rates.
- Capitalize on Rhythm built shipment plans in order to further optimize consolidation and carrier assignment.

Increased Control

- Gain control and increase efficiency with easy access to relevant, timely logistics information.
- Focus on economics of scale by applying scientific decision making capabilities to route optimization and load consolidation.
- Build accurate plans by forecasting savings and resource requirements.
- Take advantage of all modes of available transport, and maintain an accurate online database of all carrier information, including performance results.
- Create a "one-stop" environment for costing and quoting, movement tracking, and proactive shipment status notification.
- Provide immediate feedback on existing orders including anticipated delivery times and opportunities for consolidation.
- Establish and control new transportation services and options for customers.
- Benefit from extensive data capture for use in strategic decision making.
- Provide visibility of consolidated shipment planning in the common Rhythm user interface.

Freight Optimizer

Top-to-bottom management of planning /decision support and execution in the transportation and logistics processes is critical. Freight Optimizer provides powerful optimization capability in this context. In Make-to-Orders as well as in Make-to-Stock environments, the unique ability to dynamically consider multiple hub locations, pool points, and service providers when consolidating and routing shipments through the transportation network provides significant cost and service advantages. the Freight Optimizer utilizes heuristic, rules based, and Mixed Integer resolvers to yield the best solution or "optimal" load plan. When implemented as part of the total transportation solution, the optimizer considers all significant cost and service factors to develop an overall feasible, cost optimized solution for all outstanding orders (outbound, intra-company, and inbound). Freight Optimizer is a dynamic transportation routing, scheduling, and planning tool that works in conjunction with Rhythm and the Freight Management System. Freight Optimizer builds cost effective loads by consolidating shipments based on cost, infrastructure, and deliver constraints.

Loads are automatically routed either directly from origin to destination, or through multiple hub or cross-dock facilities.

The Freight Optimizer application results in significantly reduced costs and improved efficiency by allowing planners to:

- Use pre-configured carrier and hub data to route shipments based on least cost, time of delivery, or other routing considerations.
- Use Rhythm built distribution plans and carrier information from the Freight Management System for routing and rating.
- Save valuable resource time by having the system automatically build loads, route loads, and determine optimized pick up and delivery times.
- Calculate the most cost effective routing plan by comparing the results of delivering loads directly, or through hubs or cross docks.
- Save the time required for manual optimization and load building processes.
- Work with the optimized plan to build loads exactly as desired, by user interactive refinement.
- View optimized information graphically.
- Recognize hubs, shippers, consignees, and other infrastructural entities at a glance through effective graphical representation using colors and symbols.

Currently, loads are typically not planned until actual order release (1-2 days before the shipping date). the combination of Rhythm Supply Chain Planner and Freight Optimizer provides early visibility of planned order demand. This allows the transportation requests to be registered in the overall constraints based plan, resulting in delivery commitments which best leverage present carrier schedules and costs. For example, early visibility of planned order

demand might result in a decision to manufacture a product early to meet a particular rail schedule rather than waiting and shipping by truck, resulting in a substantially lower transportation cost. A key issue in the execution of any transportation plan is the availability of equipment. Early visibility of planned orders would allow transportation planners to negotiate availability of carriers based on accurate information well in advance of the requirement for that availability, which in turn results in lower negotiated rates.

Global Logistics System

The Global Logistics System (GLS) has been designed to enable logistics managers to manage risk in the logistics networks and to assist them to improve customer service while reducing cost. It also helps a business enterprise to achieve the step change in customer service performance that is critical to survival in the intensely competitive global marketplace of the 21st Century. GLS has been conceived as a generic decision support system to facilitate the management of any supply network. It sits above other operational and business systems from which it draws information in order to provide several capabilities:

- Provide the capability to model and define the performance characteristics of any supply network
- Monitor the performance of each component within the supply network on a continuing and dynamic basis
- Provide total visibility of the supply network in terms of an integrated view of orders, inventory status and processes occurring at any point in the supply network. This implies being able, at any time, to determine the location of any order or item of inventory within the supply network
- Provide proactive management capabilities which alert managers to potential disruptions in the supply network, and then provide them with contingency alternatives when these problems occur. The management capabilities also include extensive inquiry and reporting facilities
- Provide historical, statistical analysis of the performance of the supply network

GLS provides the supply chain manager with the information and decision support tools necessary to improve customer service, reduce inventory and reduce logistics costs. It also provides a valuable facility for accurately measuring the performance of service providers.

For the enterprise, GLS offers the possibility of innovative new approaches to customer service as well as the deployment and utilization of inventory. A summary of the GLS features and associated benefits is listed in the table below:

GLS provides	This ensures	Benefits
Supply Chain Control and Command	A visible and integrated view of orders, inventory, and service achievement throughout the supply chain network.	Improved customer service, reduced inventories and logistics costs with better performance from service providers.
Triple C Notifications	Pre-warning of a late delivery to the customer because of an overdue order somewhere in the supply chain.	Customer is pre-warned of a possible problem. Prompts contingency action to minimize the delay.
Contingency Planning	An immediate view of the cost	Minimizes any disruption to

GLS provides	This ensures	Benefits
	and delivery date implications of alternative routings to the final destination.	customers and speeds up the decision making process of alternate (contingency) routes.
Triple A Notifications	Three levels of warnings that an order is overdue for the next location in the supply chain.	Ensures prompt action to resolve the delay or plan contingency action.
Triple I Notifications	Warning that the maximum or minimum inventory level for a part number has been exceeded at a location.	Used to identify capacity problems and control unannounced products and hazardous materials.
Notification Status	A count of the outstanding Triple A, C and I warnings throughout the network.	Provides a snapshot of the number of failures in the supply chain.
Monitoring of Orders	Knowledge of current location, time due at next location, ETA, customer details, order details, part numbers and quantity of any order in the supply chain network.	Answers customer order inquiries quickly and efficiently.
Monitoring of Inventory	Knowledge of current location of any item of inventory in the network by part number, quantity, delivery party.	Answers customer order inquiries quickly and efficiently.
Graphical Scans	Locates orders, inventory, Triple A, Triple C and Triple I warnings on the supply chain model as color coded icons.	Visual response to an inquiry with direct access to tabular records for further details.
Tabular Scans	Details of orders, inventory Triple A, Triple C and Triple I warnings.	Customer and management inquiries can be answered in detail quickly and efficiently.
Costing	Information is available on the estimated costs of all supply chain activities.	Improves control of costs and aids comparative cost analysis between service providers.
Performance Measurement	Statistical graphs of time and cost are available at every point and consolidated at chain, group, and network levels.	Identifies poorly performing components and service providers and their impact on overall supply chain performance. It also provides a benchmark for re-engineering the supply chain.
Supply Chain Model	A complete pictorial view of the supply chain network.	Visual and flexible tool to view the location of orders, inventory, and notifications.

GLS provides	This ensures	Benefits
Designer	A tool for designing graphical representations of the supply chain.	The supply chain model can be designed and redesigned quickly and accurately, using a top down or bottom up approach.
Builder	A tool for defining and building the operational supply chain model.	Ensures the integrity of the supply chain model and the GLS database.

Alarms

The global logistics system (GLS) can be used for monitoring / alarm / alert functionality in the supply chain. The alarms detected by GLS trigger processes that are integrated throughout the entire supply chain.

Interruption to Supply

Stage	Description
1	Alarm in GLS is triggered based on an interruption to supply of packing material.
2	Alarm triggers a replan in Rhythm by which you can identify that several shipments currently planned as part of a consolidated load are not available for inclusion in that load.
3	Trigger a new load building process, based on the identified constraints, that solves the problem.
4	These new loads are again reflected in the Rhythm plan.
5	Show new inventory profiles at a DC.
6	Show new ATP's that result from the replan. This shows the tight integration between manufacturing, transportation, and distribution.

For the case in which GLS has detected that a planned shipment has not begun as planned, a proactive approach may be taken to inform the customer of a problem before the shipment shows up late:

Problem with an Outbound Shipment

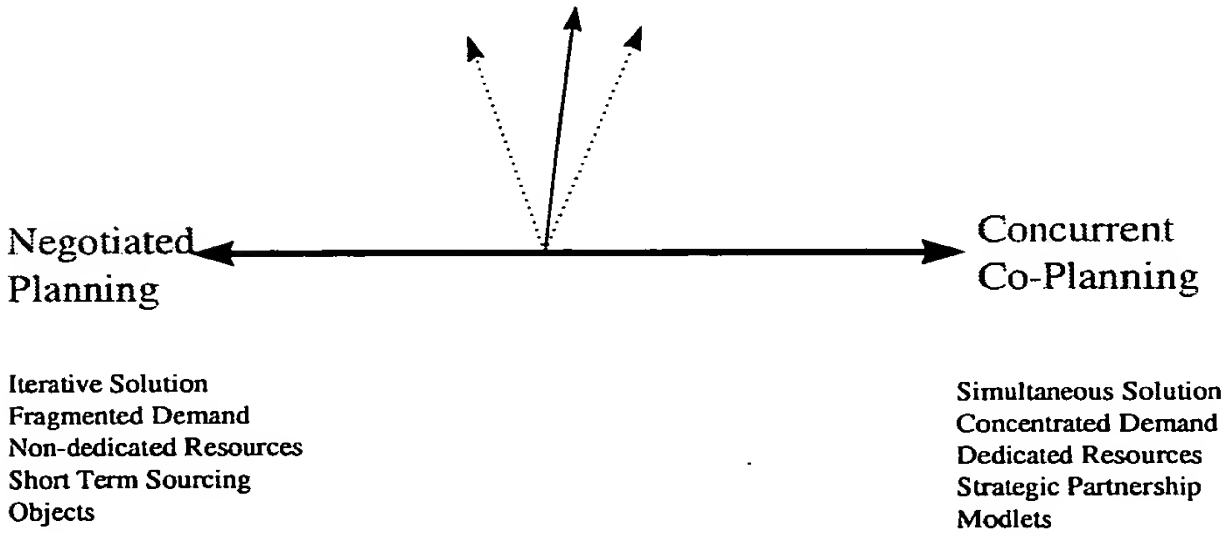
Stage	Description
1	Alarm in GLS is triggered based on a problem with an outbound shipment to a customer.
2	Alarm triggers a proactive message to both the customer and the customer service representative at the manufacturer.
3	Customer receives this message on a browser (courtesy of Inter-Enterprise Collaborative Planning).
4	Customer calls the customer service representative at the manufacturer. The customer service representative at the manufacturer has already received the message, and also has pulled up from the transportation execution system the exact known status of the shipment (courtesy of Inter-Enterprise Collaborative Planning).

Inter-Enterprise Collaborative Planning

The suite of Rhythm Supply Chain Management software provides the first solution to truly enable organizations to link multiple enterprises and actively pursue an integrated approach to balance supply with end consumer demand.

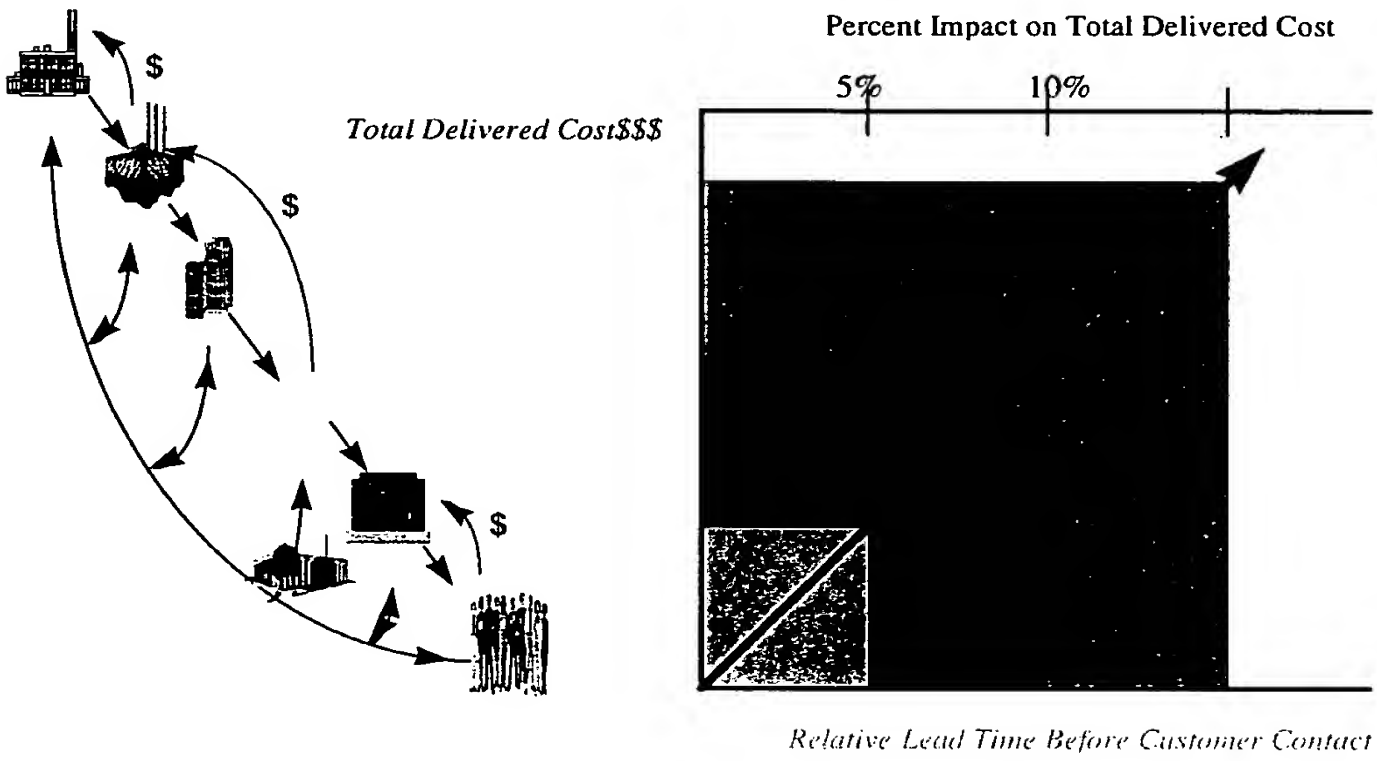
Global markets require retailers, manufacturers, and their suppliers to ensure that customers have access to the right products, when and where they want, and at minimum total delivered cost. This is required to attain a competitive market advantage. However, a supply chain can only attain sustained competitive advantage when companies within the supply chain interact together in a dynamic market. The spectrum of dynamically changing relationships spans from a negotiating, iterative collaboration, to concurrent co-planning. See Figure 3-5.

Figure 3-5: Inter-Enterprise Collaborative Planning Spectrum



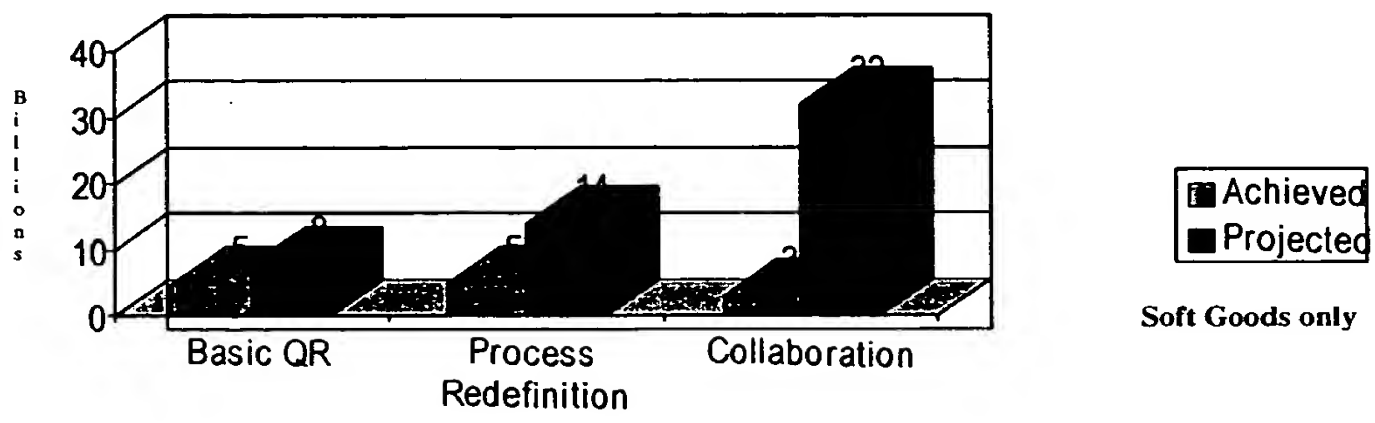
Collaborative and pro-active win-win strategies will become the standard measurement for supply chain success. Delivered results of 25% or greater inventory reductions, at significantly lower total delivered cost, will be achieved by providing real time access to all relevant information. See Figure 3-6. Immediate access to data about changes in end consumer demand and supply dynamics throughout the entire supply chain is crucial. This real time access to critical information, and the early warning time, is required to effectively react to changing market conditions. The Rhythm family of supply chain optimization products provides the necessary tools.

Figure 3-6: Total Delivered Cost - A Critical Business Issue



This increase in global supply chain visibility also paves the way for enterprise-to-enterprise collaboration and co-developed market delivery strategies. The critical requirement is the ability of partners to make decisions with full knowledge of the entire supply chain implications. This must be done in an environment characterized by multiple technology platforms and data definitions. As highlighted by many industry studies, intelligent and decision-driven collaboration delivers the greatest and most sustainable reduction in total delivered cost to consumers, and highest ROI for the supply chain participants. Figure 3-7 illustrates this point.

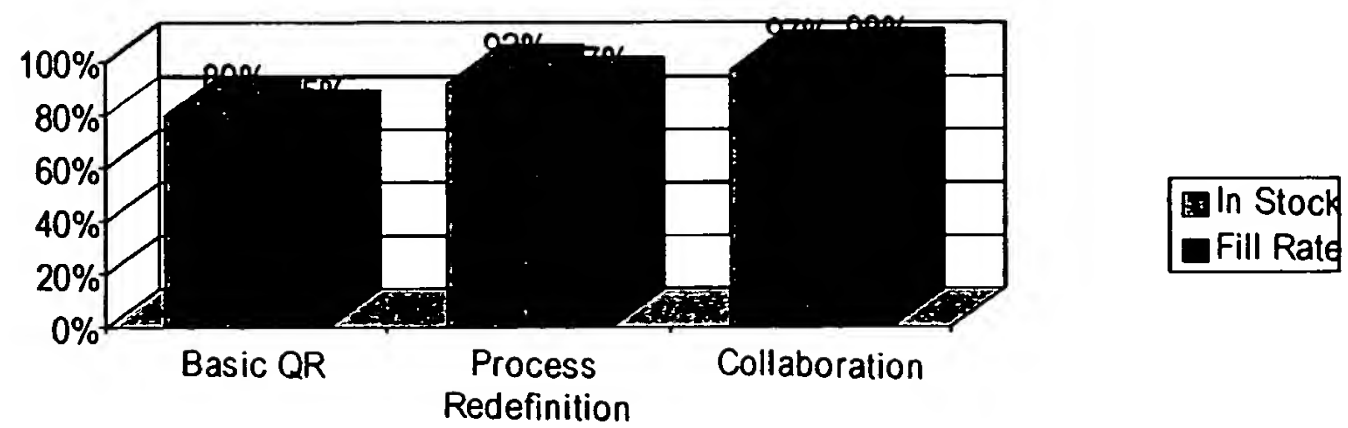
Figure 3-7: Quick Response - Embraced by Retailers and Suppliers



Source: Kurt Salmon Associates

i2's Rhythm is the first supply chain management software to provide a fully constrained feasible plan of a supply chain's delivery capability. This results in significant inventory reductions at the same time as improving fill rates and customer satisfaction. Typical fill rates for most SKU's (Stock Keeping Units) is approximately 70%. Quick Response initiatives have illustrated that, where company-to-company collaboration has been used, fill rates can be improved to 95% or greater. See Figure 3-8.

Figure 3-8: Increase Profitability Through Increased Fill Rates and Less Inventory



Source: Kurt Salmon Associates

Integrated Decision Support

The market challenge is to provide this level of performance across all products and to actively involve all supply chain business relationships. The magnitude and complexity of the challenge drives the need for software to automate this dynamic information sharing and collaboration process. Intelligent decision support engines are required to maximize the effectiveness of your supply chain strategies. i2's Rhythm integrated decision support environment uniquely achieves this by providing the following:

- One-to-many automated collaborations
- Intelligent engine-to-engine problem solving
- Integrated best practices management
- Value focused global data access
- Support for the full spectrum of business relationships
- Complete constraint-based collaboration environment
- Rapid migration from inception to business value
- Internet focus for paradigm shift
- Dynamic relationship change management
- Closed loop collaboration decision support

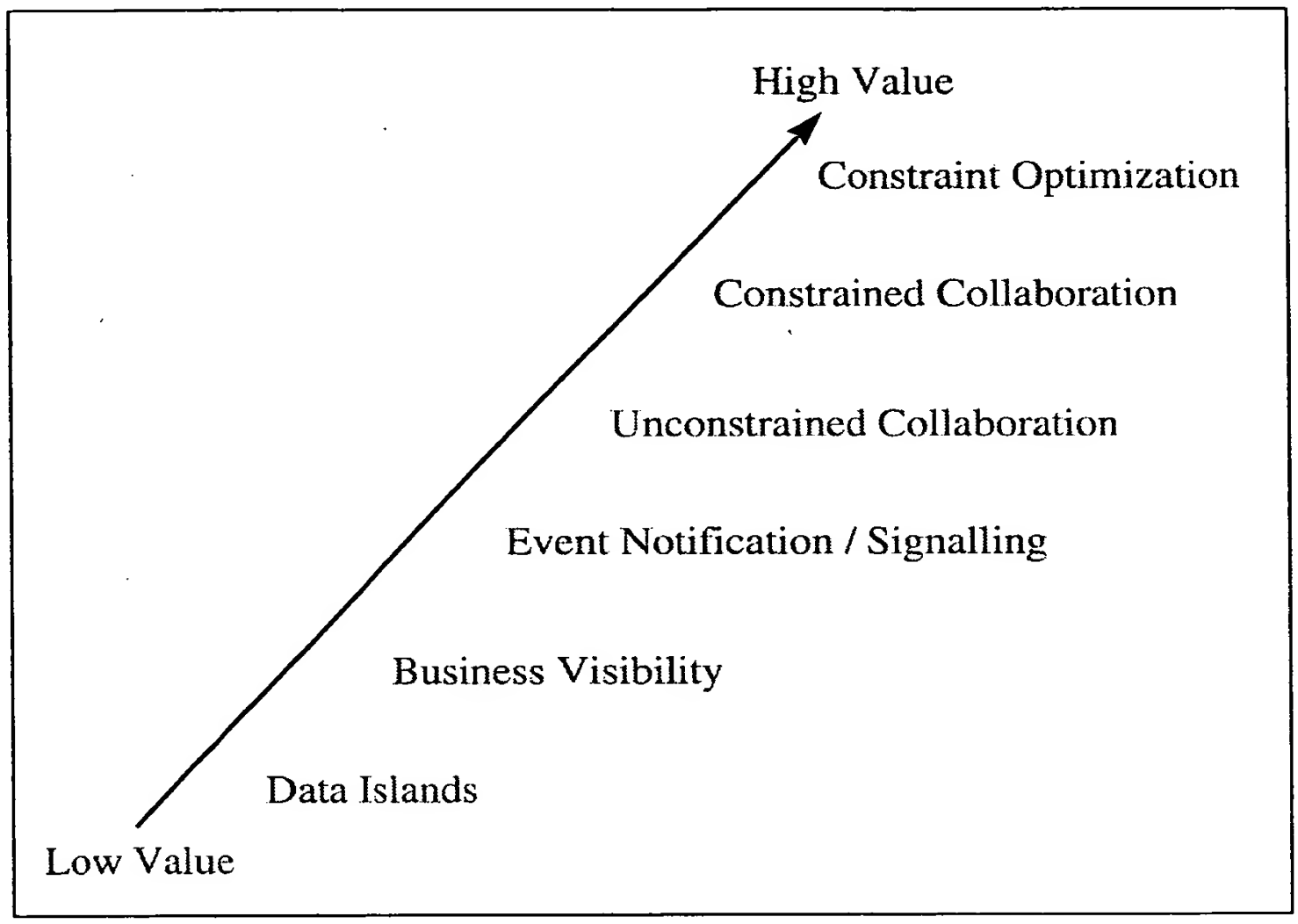
Goal of Rhythm Products

The goal of Rhythm products is to enable a level of optimization within global distributed supply chains significantly higher than would otherwise be possible. This is accomplished by the following:

- Leveraging the Rhythm SCP engines within domains and coordinating the interaction among multiple engines, including non-i2 engines.
- Facilitating rich and complex *negotiations* and dialogue among multiple control entities, rather than relying exclusively on direct and explicit control over the supply chain.
- Introducing the concept of *incentive-based* planning to give supply chain partners the incentive to behave in a manner that results in the optimization of the overall supply chain while simultaneously allowing each partner to meet its individual goals. As a corollary, disincentives could be applied to discourage behavior that is detrimental to the supply chain as a whole. An example of this is last-minute disturbances in demand or supply due to inadequate advance planning.
- Tapping into *distributed* resources across the Internet/Intranet, both within and across companies, thereby enabling better decisions to be made by incorporating richer and more complete information.
- Transforming inter-enterprise *business processes* and their supporting measurements and success criteria, and enabling a significant shortening of value-adding decision cycles.
- Providing global, inter-enterprise, real-time *visibility, signaling,* and *work-flow*.
- Incentive-based, collaborative demand and supply alignment and management, including CFAR/CPFR collaborative unconstrained and constrained demand and supply harmonization.
- Rapid transmission of filtered demand and supply signals through the inter-enterprise supply chain and integration of these signals into the plan.
- Global visibility into the state of the globally distributed supply chain, based on permissibility.
- Architecture to support growth in the network and the dynamic making, reformulation, and ending of planning relationships.
- Graphically-oriented UI with integration of data from many sources and time frames, integrated with a business process navigation paradigm.
- Capability of generating demand requests on Rhythm-SCP, and satisfying supply requests from Rhythm-SCP.
- Coordination of inter-enterprise and inter-domain supply chains in a scaleable manner.

These goals are achieved via a value migration from visibility to a fully constraint-based supply chain optimization. See Figure 3-9.

Figure 3-9: Value Migration



The Value Migration is accomplished by implementing the following functional areas and building on a base of identifying the optimal business process flow. The functional areas are visibility, signaling, and constrained collaboration. The following provides a brief description of each functional area.

Global Visibility Based on Permissibility

The key value of the global visibility functionality is a common view of key information in the supply chain that is of interest to the participants. This ensures that harmonious alignment is not frustrated by different perspectives of the same data and or circumstances. The underlying i2 technology is platform independent, enabled by dynamic object mapping, providing the capability for true supply chain wide information sharing for the first time.

One engine can have access into information under the control of another engine, restricted only by the granting of that access. This architecture supports access to the information being viewed on any platform, application software system, database, Web site, etc.

The concept of permissibility also pervades the kind of global object conversations characterized by signaling, collaboration, etc.

Initially the focus areas for visibility are as follows:

- Demand forecast and actual consumption/shipments
- Inventory status
- Order status
- Capacity availability status

Robust visibility is not provided except in those circumstances where there is a tight operational relationship among supply chain partners.

Signaling

The purpose of signaling is to alert supply chain partners of opportunities and challenges in predefined areas and activities in sufficient time to allow mutual planning to take place. Filtering allows prioritized assessment of significance (an early warning system) of the various events. Filtered signaling allows players to react to emerging circumstances before degrees of freedom to respond are lost due to time delays or data inaccessibility.

Features of signaling include the following:

- Any engine is able to signal any other engine when an event occurs that has been previously defined as representing significance to particular users.
- The definition of significant events can be supply chain wide and involve complex inter-enterprise information sharing and analysis.
- The incorporation of both memory resident and OLAP analytical capabilities allows rich analysis of emerging trends, complex causal relationships, etc. This critical information is directed to the planners and the intelligent decision support software to take full advantage of its value.
- Uses a publish-subscribe model for distributing these events that provides a clear definition of the end users who have subscribed to be informed of the event.

- The publisher/source of the data is the one who defines these events, in collaboration with the subscriber to ensure maximum use of the signal.
- The subscriber, in addition to registering interest and receiving the contents of the signal, can further perform any additional filtering when the signal is received. For example, the subscriber may customize what is defined as significant, to prioritize information.
- The underlying workflow architecture supports the notion that the signal, or a filtered version of the signal, triggers a notification of the potential need for re-planning, or activates a simulation run of the planning engine, as required.
- End users are able to define their own algorithms to be executed upon event reception. For example, the end user may wish to marry the signal data with other pre-specified sources of data to calculate the implications to market share, cost, profit, etc.

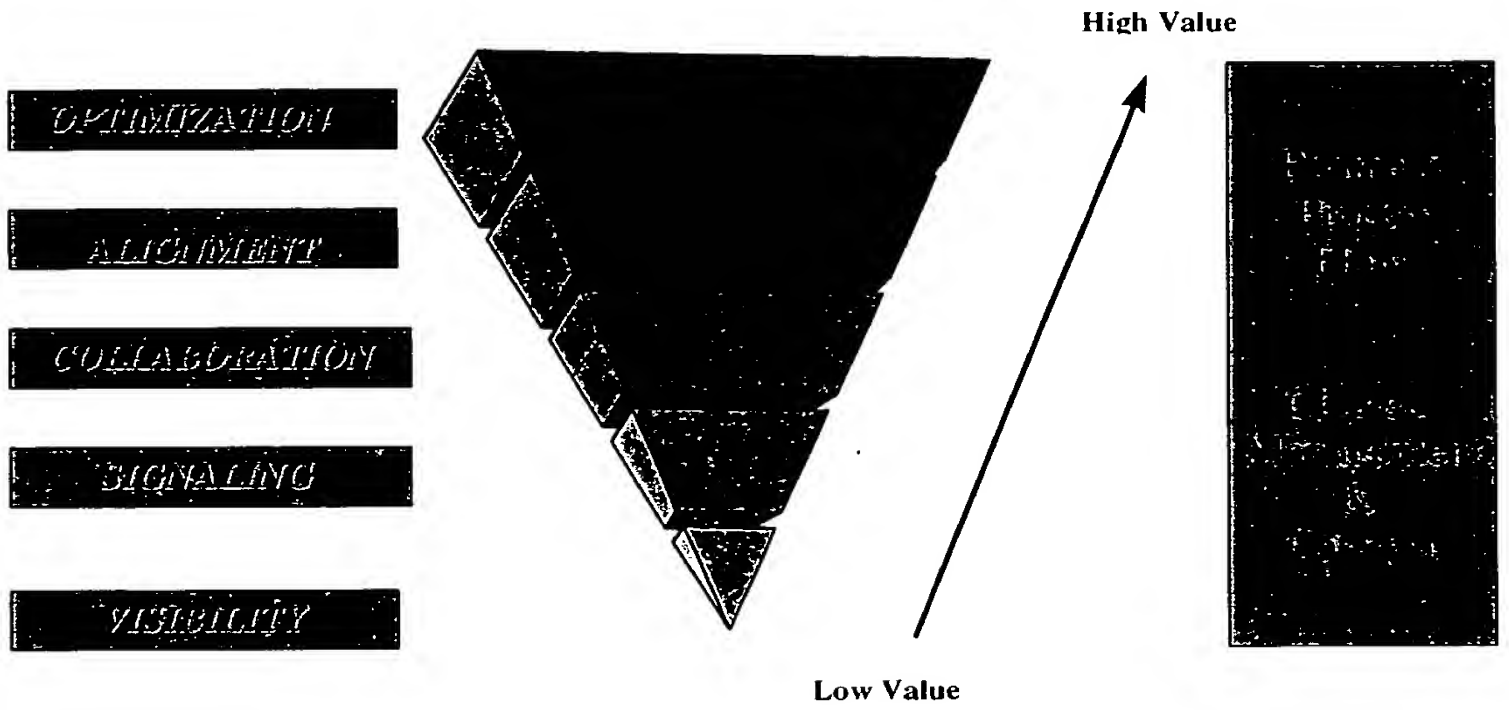
Incentive-Based Collaboration

The key element of incentive-based collaboration is the concept of collaborative demand management. Collaborative demand management is described as follows:

- Demand and supply requirements and capabilities can be placed (signaled) by either the buyer or the seller.
- Buyers and suppliers can collaborate on demand and supply in specific ways (including the potential for substitution, alternate quantities, alternate delivery dates, alternate ship to/ship from, etc.) without penalties until the specified consequence date.
- The business process and functionality is designed to encourage early modification (and discourage last minute modification) of collaborated demand and supply. This minimizes the cost/revenue impact of changes closer to the time of actual requirement.
- The collaboration algorithms automatically drive the partners towards agreement in the absence of human intervention.
- There is a single, integrated business process and time series that defines the demand profile. Orders is simply the notation given to that part of the demand profile that falls within a pre-specified time fence. Forecast demand is automatically converted to "hard order" demand through time management of the specified dates.
- The structure of the dialogue allows end users to modify or extend the collaborative logic and algorithms. For example, a user may define the granularity of the data to be reviewed in assessing and understanding a partner's demand requirements, including the formulas, assumptions, supporting third party data, business policies, etc.

The combination of visibility, signaling and constraint-based collaboration provide the first capability to optimize the entire supply chain. To attain this functionality, the Rhythm architecture provides a dynamic, modular approach to global supply chain management. This allows an organization to introduce strategic and far reaching repositioning in a step-by-step approach. Migrating through the high ROI opportunities, based on inter-enterprise optimization which directly improve profitability, becomes feasible for the first time. As shown in Figure 3-10, optimization is only achieved through constraint-based knowledge across the entire supply chain.

Figure 3-10: Achieving Optimization



Summary

The end goal of all supply chain management systems is to provide maximum value to the global markets, while providing opportunity for each participant in a supply chain to optimize profitability. i2's Rhythm solution set is the first decision support system with the intelligence, flexibility, and breadth to provide a value migration to total supply chain optimization.

On-Line Analytical Processing (OLAP) Tools

OLAP tools enable a wide range of planning and analysis applications:

On-Line Analytical Processing (OLAP) Tools

OLAP tools enable a wide range of planning and analysis applications:

- Sales and Operations Planning
- Forecasting
- Market analysis showing customer and product profitability
- Price / Volume / Mix analysis

Informational needs of strategic business issues are pervasive in companies, touching every department and almost every aspect of the decision-making process. OLAP tools help companies visualize the big picture as well as analyze details, providing a strategic view of many different business scenarios. The tools can accept transaction input, relational database information acting as a data warehouse repository, and spreadsheets which in many cases are the primary source for business projections. OLAP tools consolidate this information from various sources with data derived from analytical computations and make it available to users through standard desktop products such as spreadsheets, query tools, report writers, and browsers. The result is a comprehensive, analytical view of your business providing the ability to make faster and better informed decisions.

Rhythm's Distribution Intensive solutions currently use OLAP tools to perform the following functions:

- **Sales and Operations Planning (SOP)**

  The business problem that is being solved here is determining the "best" case estimate of market demand. Using historical data (both planned and actual) for order fulfillment service levels and safety stock, along with forecasted demand and safety stock levels (which, when added together, establish the current demand plan), the OLAP tool is able to point out specific conditions in which inventory plans have been insufficient to satisfy target service levels and/or suspected inventory levels that far exceed demand patterns. By combining the past with the present, planners can adjust the inventory plan through the dimensional analysis of the tool.

- **Forecasting**

  An OLAP tool is used to analyze forecasts by product and sales channel hierarchies. The business problem that is being solved is establishing minimum and maximum inventory limits that are date effective to demand fluctuations such as seasonality, and that will control the forecast from being over or under estimated. The analytical tool can highlight specific conditions in which demand fluctuations are "out-of-bounds", so a determination can be made as to whether these conditions are repeatable. The results of this step provide input to the SOP process.

OLAP tools provide a multidimensional database that allows you to simultaneously share, analyze, and update data using an unlimited number of dimensions. Rhythm's product solutions provide choices as to the type of OLAP engine preferred. However, Rhythm solutions provide standard dimensional templates for functional areas using OLAP tools such as Essbase® from Arbor® Software.

Optimal Planner

Optimal Planner (OP) is a PC based decision support software tool that enables companies to plan their manufacturing and distribution operations better. Better planning improves the ability of companies to make, move, store, and sell their products, and ultimately to compete in the marketplace. Better plans improve efficiency and effectiveness and lead to better business results:

- Higher customer service
- Higher asset utilization
- Lower costs

OP provides intermediate range tactical planning of the supply chain, from material supply through multiple stages of manufacturing, distribution, and customer demand.

OP provides state-of-the-art capability that is built around mathematical optimization technology to suggest cost-minimizing, capacity-feasible tactical plans to develop integrated production, distribution and inventory plans. It helps determine when, where, and in what quantity to produce, ship and store finished products to meet customer demand and to maintain inventories. Theses tactical plans can then be used to "drive" more detailed, downstream, scheduling tools such as production scheduling and inventory deployment scheduling.

Specifically, OP can be used to analyze such issues as:

- Product allocations to production locations and production lines.
- Inventory builds required to meet high seasonal demands.
- Trade-offs between overtime production and building inventory.
- Transportation volumes down shipment lanes.
- Flexible sourcing of distribution centers from multiple production locations.
- Timing and sourcing of raw material purchases.
- Flexible sourcing of distribution centers from multiple production locations.
- Effects of limited supplies of key raw materials on production and distribution.

OP helps you define the best way to produce and distribute products in weekly buckets during the first few weeks, monthly buckets for the balance of the current year, to quarterly buckets for the balance of the second year.

OP contrasts sharply from traditional planning tools like MRP II and DRP. These tools are severely limited in their ability to suggest plans which utilize scarce capacity effectively, minimize costs, or integrate data from different points in the supply chain.

Supply Chain Planner

i2 is a supplier of an integrated decision support system for global supply chain management. i2's global supply chain manager addresses the principle business drivers of Return on Assets, Delivery Performance, Profit Contribution, and Responsiveness (Order Lead Time) with product quality understood as a given. Using a new approach, i2 provides its customers a method to achieve significantly superior results in these key business drivers. This new approach does supply chain planning concurrently rather than sequentially. Distribution, transportation, sourcing, allocation, manufacturing, and procurement plans can be simultaneously formed. These plans recognize and accommodate all of the constraints in the chain: material, capacity, manpower, transportation, warehousing. The system also handles in real-time the bi-directional propagation of "changes." This bi-directional planning provides the ability to see problems and changes without the need to go back to the starting point of the planning process, make modifications, and uni-directionally pass them back through the process. The uni-directional start-over process loses the cause and effect relationship that is necessary to effectively solve these unforeseen problems.

Another advantage of this approach is that it allows very rapid what-if analysis for large and complex problems. i2's global supply chain manager makes it easy for you to perform the following types of what-if analysis:

- When can a new product be shipped to a key customer? How many can be shipped by a certain date? When can a certain amount be shipped?
- What locations or channels should receive allocations of product?
- What mode of transportation and which carriers should be used? What should the routing be?
- Is capacity being allocated among key customers or channels in the most profitable way?
- Which work centers are impacted the most by the new forecast?
- What is the overall effect on the supply chain due to the forecast change?
- Which orders will be impacted by a late component delivery from a supplier?
- What materials need to be expedited and how much overtime is required to meet a new and unplanned order?
- Which subassemblies or fabrication efforts can be delayed because an order has been put on hold for two weeks?

In traditional manufacturing systems, you must go through several different applications taking hours or days to answer these questions. i2's global supply chain manager allows you to answer these questions literally in seconds. i2's global supply chain manager is flexible so that it can be used to answer these questions in a wide variety of environments. It is designed to be used in multiple distribution or plant situations as well as for planning the operations of

individual facilities. It takes into consideration everything from customer's demands to supplier's capabilities. In a distributed, multi-company enterprise, companies for the first time can tie the entire supply chain into one real-time, concurrent planning environment.

Supply Chain Strategist

Top-to-Bottom Supply Chain Management

i2 provides top-to-bottom strategic management by executing transportation and logistics management solutions. The Supply Chain Strategist application is a decision-support tool designed to facilitate strategic and tactical planning for the entire Supply Chain network. It allows you to quickly and easily consider alternative planning scenarios. Examples of the decisions considered include the following:

- Number, size, and location of manufacturing and logistics facilities.
- Manufacturing and logistics capabilities and capacities of a facility.
- Strategic sourcing decisions.
- Channels of distribution.
- Customer service and replenishment assignments.

The modeling entities used by Supply Chain Strategist are highly compatible with the i2 modeling paradigm (sites, suppliers, plans, operations, resources, buffers) for strategic decision-making. The combination of Supply Chain Strategist, Rhythm Supply Chain Planner, and Freight Optimizer results in full management solution. This integration improves the results and accelerates the speed and ease of strategic analysis.

Supply Chain Strategist Description

Supply Chain Strategist is an analysis and modeling tool that provides managers with insight into the cost and service tradeoffs across the supply chain, from sourcing through manufacturing to end customer distribution.

Supply Chain Strategist allows for exhaustive and insightful analyses and enables customers to make more accurate and effective decisions. This results in flexible, efficient, and effective supply chain integration, as well as service improvements and cost reductions. Individual companies who have effectively used the Strategist have each gained millions of dollars in reduced costs.

By using Supply Chain Strategist, organizations can develop the strategic and tactical plans that will exceed customer expectations while maximizing the total value added through the supply chain. This is accomplished by allowing you to perform the following:

- Determine the optimal number, size, and location of manufacturing and logistics facilities.
- Plan cost efficient and service effective flow of products through the entire supply chain.
- Design plans that simultaneously fulfill the requirements of multiple customer service segments.

- Evaluate the entire supply chain structure on a global scale.
- Establish cost and service trade-offs of alternative procurement, manufacturing, and distribution strategies.
- Focus analysis on specific stages of the supply chain or on an integrated strategy for all sourcing, manufacturing and distribution activities.
- Build accurate fixed and variable cost models for each facility, process, product, and transportation mode.
- Link to conforming databases to access historical performance information.
- Dynamically view the impact of "what-if" scenarios.
- Generate plans at a detailed or executive summary level.
- Create customized geographic, tabular, and graphical reports.

4. Functional Descriptions

Function Summary

The following table provides a brief overview of each function and the key benefits of the function. Each function is described in more detail, in alphabetical order, following the table.

Function	Description	Key Benefit(s)
Strategic Network Rationalization	Supply Chain Strategist functionality provides managers with insight into the cost and service tradeoffs across the supply chain, from sourcing through manufacturing to end customer distribution.	It allows for exhaustive and insightful analyses and enables customers to make more accurate and effective decisions. This results in flexible, efficient, and effective supply chain integration, as well as service improvements and cost reductions.
Demand Management	Forecast Planner functionality that generates forecast creation and promotions planning.	
Sales and Operations Planning (SOP)	Forecast Planner functionality that generates inventory planning and optimized Master Planning.	
Available To Promise (ATP)	Allocated ATP is part of Rhythm's Demand Management functionality that provides the capabilities companies need to allocate product, make immediate and reliable delivery promises, and then to monitor those promises against the company's actual order fulfillment.	Rhythm's ATP functionality offers benefits over traditional ATP mechanisms because it considers the entire demand/fulfillment process in real time.
Inventory Deployment	Global Logistics System functionality provides a visible and integrated view of orders, inventory, and service achievement throughout the supply chain network.	
Manufacturing Planning		
Transportation Planning	The Transportation Optimizer provides the ability to include a cost "optimized" transportation plan. Using a combination of sophisticated solver algorithms and mixed integer programming, the Optimizer will produce a least cost transportation plan subject to real world constraints.	The end result is a lower pro-rated cost per shipment and consequently an overall lower cost of transportation.
Transportation Scheduling	The transportation scheduling functionality is used to rate, route, and complete complex consolidations across an entire enterprise,	It groups shipments and loads across an entire enterprise, multiple enterprises, and supply chains. More savings are realized as more

	group of enterprises, multiple hubs/cross-docks or supply chains.	opportunities exist for consolidation on inbound and outbound transportation, driving vehicle utilization up and costs down.
Manufacturing Scheduling and Sequencing		
Supply Chain Monitoring and Control	Global Logistics System functionality provides a visible and integrated view of orders, inventory, and service achievement throughout the supply chain network.	Improved customer service, reduced inventories and logistics costs with better performance from service providers.
Outbound Logistics / Customer Service Tracking	Global Logistics System functionality provides a visible and integrated view of orders, inventory, and service achievement throughout the supply chain network.	
Multi-Enterprise Collaboration	Forecast Planner and Inter-Enterprise Collaborative Planning functionality combine to enable collaborative forecasting. This includes the retailer and vendor working together to establish a forecast and a replenishment plan.	The architecture allows for management of information across multiple sites, divisions and customers as well as optimization / planning across the whole domain. It creates a mutually agreed upon plan that can be used directly by both demand management and SCP.

Inventory Deployment

Deployment planning entails determination of the specific amount of product t oship in the very near term considering simultaneously the replenishment needs of the DCs and the available supply at the source. Many DRP systems that incorporate deployment carry out the latter function after finished goods requirements have been calculated, and as stated before, there exists the assumption that supply will be available in DRP. When deployment planning is subsequently performed and it is found that supply is short or that product in excess of requirements has to be pushed to the DCs, the inventory and transportation plans cannot be realized and must be redone. However, the positioning and availability of resources such as trucks and crews to handle loading and unloading are most probably going to be misaligned with the true requirements. The deployment function that relies as a starting point on requirements that were generated by the DRP system will most likely not recognnize the relative priorities of the requirements because it will not have a view of the details behind the requirements such as key customer orders. In SCP deployment planning is an integral part of DRP. It merely represents the shorter term of DRP and explicitly considers key customer orders, inventory positions, supply of product (on hand and scheduled production), and transport and warehousing resource availability. It also ensures that the replenishment plans result in the appropriate shipping quantities such as pallets or tiers, and that these fit in the appropriately sized containers in either full load or less than full load quantities, whichever is correct for a particular product and a particular lane.

Transportation Planning

This section is to present the concepts, terminology, and benefits of transportation planning and execution that will be achieved with Freight Optimizer, Freight Management, and Supply Chain Planner.

The driving force behind a truly integerated supply chan planner and transportation planning is the ability to offer planners the ability to create optimal supply plans at the lowest achievable transport cost. This lowest cost can only be obtained if planning spans the entire supply chain of a typical CPG company and considers transportation constraints and cost saving opportunities as it derives plans for the flows of products from location to location.

Considering that for many CPG companies the highest value added component of their operations lies in transporting materials to the plants and finished goods to their DCs and customers, it is clear why integrated supply and transportation planning offer a huge opportunity that traditional methods cannot capture due to the lack of integration of transportation planning with supply planning.

The following discussion provides descriptions of how integrated supply and transportation planning functions work within the context of the planning funnel, moving from medium term planning through execution and performance measurement.

The entire supply chain is encompassed in transportation planning. Transportation planning spans the full range of planning horizons as shown in the planning funnel.

In the tactical planning stages, SCP calculates replenishment shipments to obtain optimal loads. It then passes these shipments to FO for route planning and transportation execution. Order processing passes customer orders and an ERP system passes vendor release notices to Freight Optimizer for optimal load consolidation and routing.

Transportation Scheduling

- Load Consolidation
- Route Optimization

The transportation scheduling functionality is used to rate, route, and complete complex consolidations across an entire enterprise, group of enterprises, multiple hubs/cross-docks or supply chains. The ability to increase the utilization of vehicles, for example by consolidating less than truckload shipments into truckload shipments, is a major cost reduction driver.

The Freight Optimizer load consolidation application groups shipments and loads across an entire enterprise, multiple enterprises, and supply chains. More savings are realized as more opportunities exist for consolidation on inbound and outbound transportation driving vehicle utilization up and costs down. Consider the savings for a computer parts distributor that can, by using this application, consolidate inbound transportation for shipments from Compaq, Dell, and IBM. This consolidation would occur across various manufacturing locations or distribution centers via a common hub or pool point with outbound transportation consolidation for shipments to common retail or service center locations; or a third party logistics company that manages parts distribution for multiple auto manufacturers to their respective dealerships - the leverage of coincidence of delivery i.e. multiple auto manufacturers generally have dealerships clustered in the same geographic location - is significant.

These consolidations can occur, while still being able to prorate transportation charges back to specific shipments for specific divisions within a multi-division enterprise within a multi-enterprise consortium. The profitability of individual transportation moves or the profitability of a single leg move within a multi-leg move can be tracked. Shipment location / status by line item detail can also be tracked throughout the supply chain even though consolidation may be occurring across disparate entities.

Multi-Enterprise Collaboration

- Forecast Collaboration

  (Product: Rhythm Forecast Planner)

(Product: Rhythm Inter-Enterprise Collaborative Planning)

Multi-Enterprise Planning and Execution

Rhythm's multiple domain architecture allows for planning across multiple enterprises. The Freight Management logistics architecture provides for planning and execution of the transportation and warehousing functions across multiple enterprises. The architecture allows for management of information across multiple sites, divisions and customers as well as optimization / planning across the whole domain. For large multi-national customers and third party logistics providers, this is a core requirement.

Multi-Enterprise Participants

Who	Action . . .	. . . What
Retailer	communicates	an unplanned promotion to manufacturer looking for the following information: Is this unconstrained number reasonable based on your knowledge of the market? How much of this volume can you support?
Manufacturer	evaluates	the market potential, and sends proposed volume into SCP for constrained capability.
Manufacturer	communicates back	feasibility in terms of market potential and constrained ability to deliver.

Retailer - Manufacturer Trading Relationships

The types of trading relationships that a retailer might have with a vendor are as follows:

- Collaborative forecasting
- Customer managed replenishment
- Vendor managed replenishment
- Passive key accounts
- Passive "other" accounts

Note that a single retailer could have relationships of several types with an individual vendor for different ship-to-locations and products. It is intended that these relationships be mutually exclusive.

The implications of these relationships are as follows:

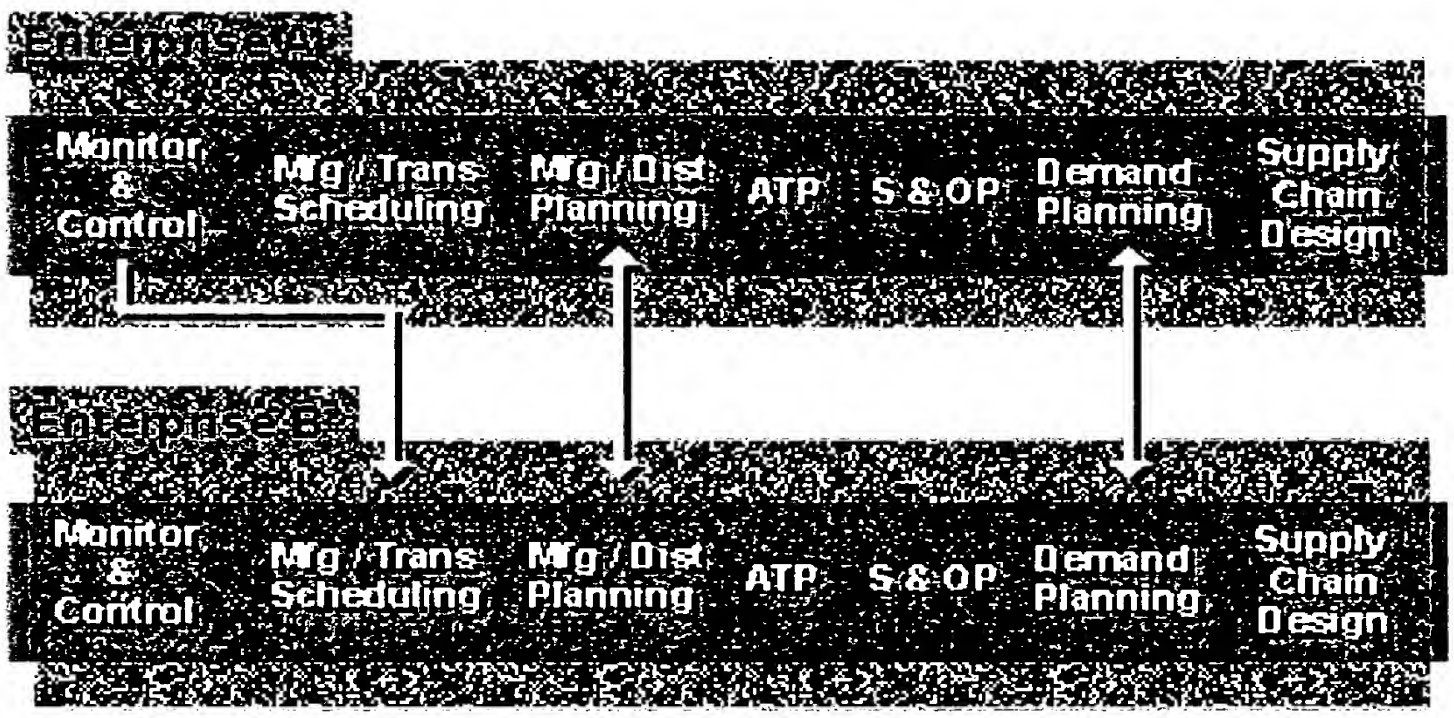
- The type of information used to create a base forecast differs.
- The way that the customer location is represented in a vendor's Supply Chain Planner model differs depending upon type.

Collaborative Forecasting

Collaborative forecasting includes the retailer and vendor working together to establish a forecast and a replenishment plan. An important characteristic of collaborative forecasting is that it creates a mutually agreed upon plan that can be used directly by both demand management and SCP. The plan consists of both a forecast and a replenishment (shipping) plan. The plan may consist of several issues:

- Multiple horizons
- A committed horizon within which the partners agree that there will be no changes
- A firm plan where limited changes are allowed
- A future plan which is provided for long term planning

Figure 4-11: Multi-Enterprise Collaboration



Customer Managed Replenishment

Customers create a forecast and a replenishment plan based on the forecast. They share this forecast with the vendor and expect the vendor to ship according to the plan. As with collaborative forecasting, the plan consists of both a forecast and a replenishment (shipping) plan. The plan may consist of the following item:

- Multiple horizons
- A committed horizon within which the partners agree that there will be no changes
- A firm plan, where limited changes are allowed
- A future plan which is provided for long term planning

The EDI standard used to support communicating these plans is the UCS 830, although the Uniform Code Council is extending the UCS 852 transaction to accommodate a forecast and a forward looking replenishment plan.

Customer Managed Replenishment is not widely used in CPG.

Vendor Managed Replenishment

Vendor Managed Replenishment (VMR) is the most common form of automated replenishment in operation today. In its simplest form, the retailer provides the vendor with sales information (often retail DC to store shipments) and DC

inventory balance. The vendor creates a forecast and uses that forecast to determine if more product should be shipped and the quantity of the shipment. Most of these systems are order point in nature and do not have a forward looking plan as a part of the business process beyond the vendor's normal forecasting function. The vendor is expected by the retailer to meet certain targets: inventory turns and service to stores. Vendors may suffer financial penalties if they do not achieve these goals.

VMR relationships may be included in a corporate forecast, but often are not. The order point nature of the order generated means that most VMR systems do not have a forward looking plan. Therefore, the service level targets can be difficult to achieve without substantial extra safety stock. This safety stock ensures that, in filling current day orders, vendors do not short future VMR orders that they cannot see. i2 supports a forward looking VMR process by explicitly forecasting demand for each VMR account and explicitly including the customer's DC in the Supply Chain Planner (SCP) model.

Variants of this relationship include the following:

- Joint promotion planning and forecasting.
- Generation of replenishment plans by the vendor which are forward looking.

The Vendor Managed Replenishment relationship is also known as the following:

- Vendor Managed Inventory (VMI)
- Continuous Replenishment Programs (CRP)
- Efficient Consumer Response (ECR)
- Quick Response (QR) - predominant in the apparel industry

Passive Key Accounts

Passive key accounts are accounts that have the ability to significantly affect the vendor operations through placing unplanned orders. Typically, this account would be a large wholesaler. The vendor explicitly creates a forecast for these accounts and reserves inventory for them.

Passive Other Accounts

Forecast as a single entity, the group of passive "other" accounts represents the 80% of accounts that do 20% of sales. The vendor does not reserve inventory for this group of accounts.

5. The Organization Example

Strategic Supply Chain Analysis and Design

Just like most of today's companies, Cereal, Inc.'s supply chain has evolved over time as the company grew from its original plant site to the current three plant sites and four distribution centers (two of which are combined production and distribution sites). This piecemeal evolution has resulted in autonomous sites, each with their own measurement systems, typically specialized by product lines, with independent functional areas in procurement, production, transportation, and warehousing. What has driven these decisions in the past is the competitive battleground of price. As a result, the existing supply chain evolved around the primary goal of cost efficiency. Reducing costs provided pricing leverage to compete in the market.

Market emphasis has changed. The competitive battlegrounds that have emerged are time and flexibility. Demand varies due to a couple of dynamics: seasonality and promotional emphasis. In the past, large orders were placed for seasonal build-ups and promotions due to extended production lead times. But today's customer does not want the inventory carrying cost resulting from long delivery times. Improved service requirements (read time as a competitive battleground), such as reduced ordering cycles, increased order fill rates, and responsive deliveries, is what maintains market share. In addition, markets are continually fragmenting. Consumers want it their way - configured to their specific needs. It is a detriment that they should pay for something that they do not want. Therefore, there is an increased risk of product obsolescence when large volume, promotional orders are placed. Unsuccessful market acceptance will result in margin reduction and lost revenue. Today customers demand promotional flexibility, but combined with responsiveness that adjusts to the increased customization needs.

Markets are now global. No one is secure in their market "turfs" with an identified set of competitors and customers. Competition has emerged from all over the globe providing new sources of supply, but also opening up new vistas of opportunity. Trade barriers have been removed eliminating many of the restrictions to effectively market and service these new markets. But this expands the packaging configurations and labeling resulting in a proliferation of stock-keeping-units in which to manage.

Cereal, Inc.'s management has recognized these changing market trends and competitive pressures. It is imperative that the company get closer to the market and reduce their product lead times. Cereal, Inc. understands that they must increase asset utilization, consolidate raw material procurement, reduce the Distribution Center replenishment lead times and resulting inventory levels to stay competitive. To address these issues, management has undertaken a study

using the Rhythm Supply Chain Strategist tool. What needs to be analyzed are the following:

- To move closer to the market, should there be new Distribution Center locations that will provide better servicing capabilities to the market?
- Test the cost / service tradeoff between specialized product plants vs. multi-product plants through flexible production and packaging lines.
- Determine the effects of consolidated procurement strategies that will take advantage of economies of scale on raw materials and packaging components.

The Supply Chain Strategist is a powerful analysis and modeling tool that provides insight into the cost and service tradeoffs that exist in the supply chain, from sourcing through to manufacturing and distribution. It assists an organization in developing both strategic and tactical plans that will meet and / or exceed the markets expectations while maximizing to total value added throughout the supply chain. With the ever expanding and changing markets of today's competitive environments, Supply Chain Strategist helps a company constantly review its operations network in order to address growing customer demands and changing market conditions. As a result of their study, Cereal, Inc. management decided to do the following:

- Shut down the old, high-cost plant in favor of a newer, more efficient, multi-product plants.
- From a short list of four potential sites, Dallas was selected as a new Distribution Center.

This strategic plan should result in the following benefits:

- Consolidated purchasing will reduce the number of raw material and packaging suppliers. As a result, procurement costs will be reduced through larger volume orders to the remaining vendors.
- Multi-product plants will result in reduced replenishment lead times for Distribution Centers. Sourcing sites are increased providing replenishment flexibility. It follows that reduced lead times result in smaller order sizes, thus reducing finished goods levels. However, improved planning will increase order fill rates.
- Better positioned sites that align to the servicing goals of the market will result in larger shipment sizes and reduced transportation costs.

Three Years Ago...

As we roll the clock back three years, Cereal Inc. was in dire straits. Like many CPG companies, Cereal, Co.'s supply chain had evolved over time as the company grew from its original plant site in Nebraska to four plants and three

DCs across the U.S. This piecemeal evolution had resulted in autonomous plants, each manufacturing a unique product line and supporting independent functional areas of procurement, production, transportation, and warehousing.

As with many CPG companies, Cereal Inc.'s existing supply chain evolved primarily driven by a goal of cost-efficiency, not customer service or responsiveness. Reducing costs provided pricing leverage to compete in the market. Each individual operational component was "optimized" individually, but never as an entire enterprise, focused on customer service.

Cereal Inc.'s management recognized that the market's requirements had changed. The previous delivery standards could not move the company forward in the customer-service driven world of CPG. In fact, management had seen the highly competitive marketplace erode Cereal Inc.'s market share over the past several years.

Speed & Flexibility: Competitive Battlegrounds in the CPG Marketplace

Sophisticated customers rule the CPG marketplace. Seasonality and promotions drive demand variability. In the past, large orders were placed for seasonal build-ups and promotions due to extended production lead times. Today's sophisticated customer fully understands the inventory carrying cost results from long delivery times. Improved speed to market (including reduced ordering cycles, increased order fill rates, and responsive deliveries) maintains market share.

Speed alone is not the answer; flexibility is required to serve dynamic, continually fragmented markets. CPG consumers want it their way - configured to their specific needs. Therefore, manufacturers risk product obsolescence when large-volume, promotional orders are placed. Unsuccessful market acceptance results in margin reduction and lost revenue. Today customers demand promotional flexibility combined with responsiveness that adjusts to the increased customization needs.

Requirements for Success

Cereal, Inc.'s management had recognized these trends and competitive pressures. They were aware that the company must move closer to the market and reduce its product lead times to stay in business. Management had to find a solution that would fulfill the following needs while meeting the market's requirements at a minimum cost:

- Increase asset/capacity utilization
- Consolidate raw material procurement
- Reduce DC/Customer replenishment lead times

Finding the Solution Path

After an exhaustive search of the marketplace, Cereal Inc. acquired the Supply Chain Strategist (SCS) and initiated the optimal planning of the entire supply chain – from raw material procurement through finished goods deliveries.

The Supply Chain Strategist is a powerful and intuitive analysis and modeling tool that provides insight into the cost and service tradeoffs that exist within an enterprise's entire supply chain. It assists an organization in developing a strategic plan that will meet or exceed the market's expectations while maximizing total value added throughout the supply chain. In today's dynamic competitive markets, the Supply Chain Strategist allows a company to continually optimize its operations network to meet growing customer demand and changing market conditions.

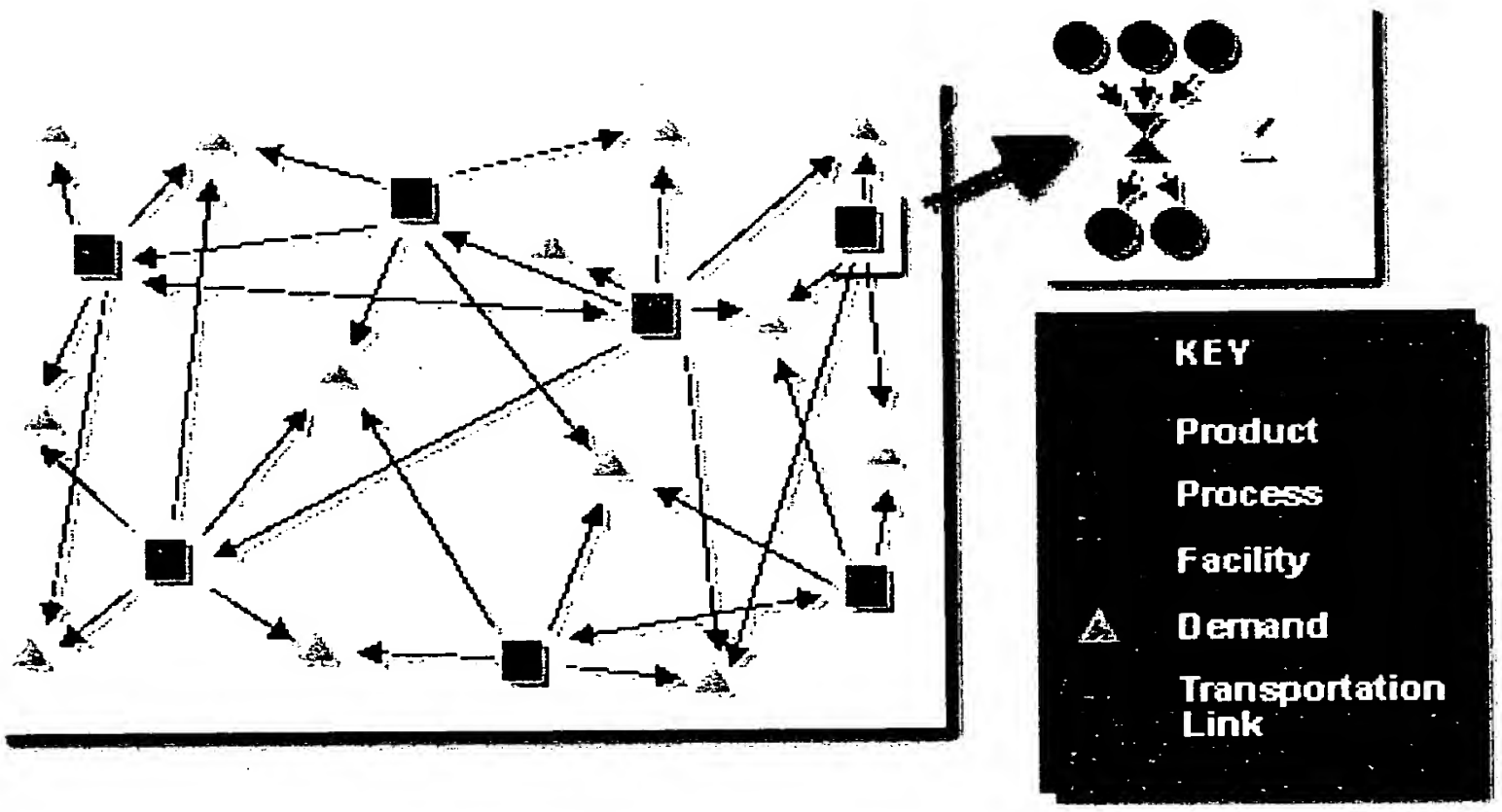
The Modeling Paradigm – Fitting the Model to the Problem, not the Problem to the Model

Building the model within the Supply Chain Strategist tool is a straightforward, efficient process. The tool's flexible and powerful Modeling Paradigm allowed Cereal Inc. to build both simple and complex supply chain models using the same set of entities or "Building Blocks." These Building Blocks include Facilities, Products, Processes, Demand Regions, and Transportation Links.

The SCS Modeling Paradigm allows a generalized modeling approach without forcing the network into a rigid echelon-based structure. Individual entities are permitted to play multiple roles. For example, a facility may be supported by a variety of processes that define its role in the network. A single facility may source raw materials as well as function as a manufacturing plant. On the other hand, products that function as raw materials to a process may also be demanded as finished goods.

The flexible modeling environment permitted Cereal Inc. to customize and assemble model components to represent real-world scenarios. This concept allows the modeler to *fit the model to the real-world problem, rather that trying to fit the real-world problem to the model.*

Figure 5-1 Modeling Paradigm



Evaluating the Existing Supply Chain

Cereal Inc. first analyzed its current, inefficient supply chain with the SCS tool. This analysis served several purposes:

- Provided the modeler with graphical and tabular access to review the existing supply chain costs, capacities, flows, and service territories.
- Provided a benchmark with which to compare alternative supply chain strategies.
- Served to validate the data in the model with the current real-world network.

This "Simulation of the Baseline" allowed Cereal Inc. to identify some potential inefficiencies of the network – even prior to any optimization. With this capability, Cereal Inc. determined several of the network strategies to model and optimize.

Cereal Inc.'s Potential Network Strategies to Analyze:

- *Additional DCs*: To move closer to the market, evaluate potential Distribution Center locations that will provide better servicing capabilities to the market.
- *Single Product Line Plants vs. Multi-line Integrated Plants*: Evaluate cost / service tradeoff between specialized product plants vs. multi-product plants through flexible production and packaging lines.
- *Rationalize Supplier Base*: Determine the effects of consolidated procurement strategies that will take advantage of economies of scale on raw materials and packaging components.
- *Production Postponement:* Postpone packaging of cereal to reduce finished goods inventory levels and provide greater flexibility to react to demand variations.

Results of Optimization Runs – Action Steps

As a result of the study, Cereal, Inc. management took the following action steps:

Step	Action
1	Integrated the manufacturing at San Jose, Chicago, and Buffalo plants, expanding from one product line at each to multiple product lines.
2	Shut down the old, high-cost plant at Nebraska in favor of newer, more efficient, multi-product plants in the other three locations.
3	Selected Dallas as a new DC location from a short list of four candidates.
4	Consolidated purchasing to reduce the number of raw material and packaging suppliers, resulting in procurement cost reduction through larger volume orders to the remaining vendors.
5	Currently evaluating production postponement benefits and implementation feasibility.

The Supply Chain

Cereal, Inc. has three plants that process and pack its products:

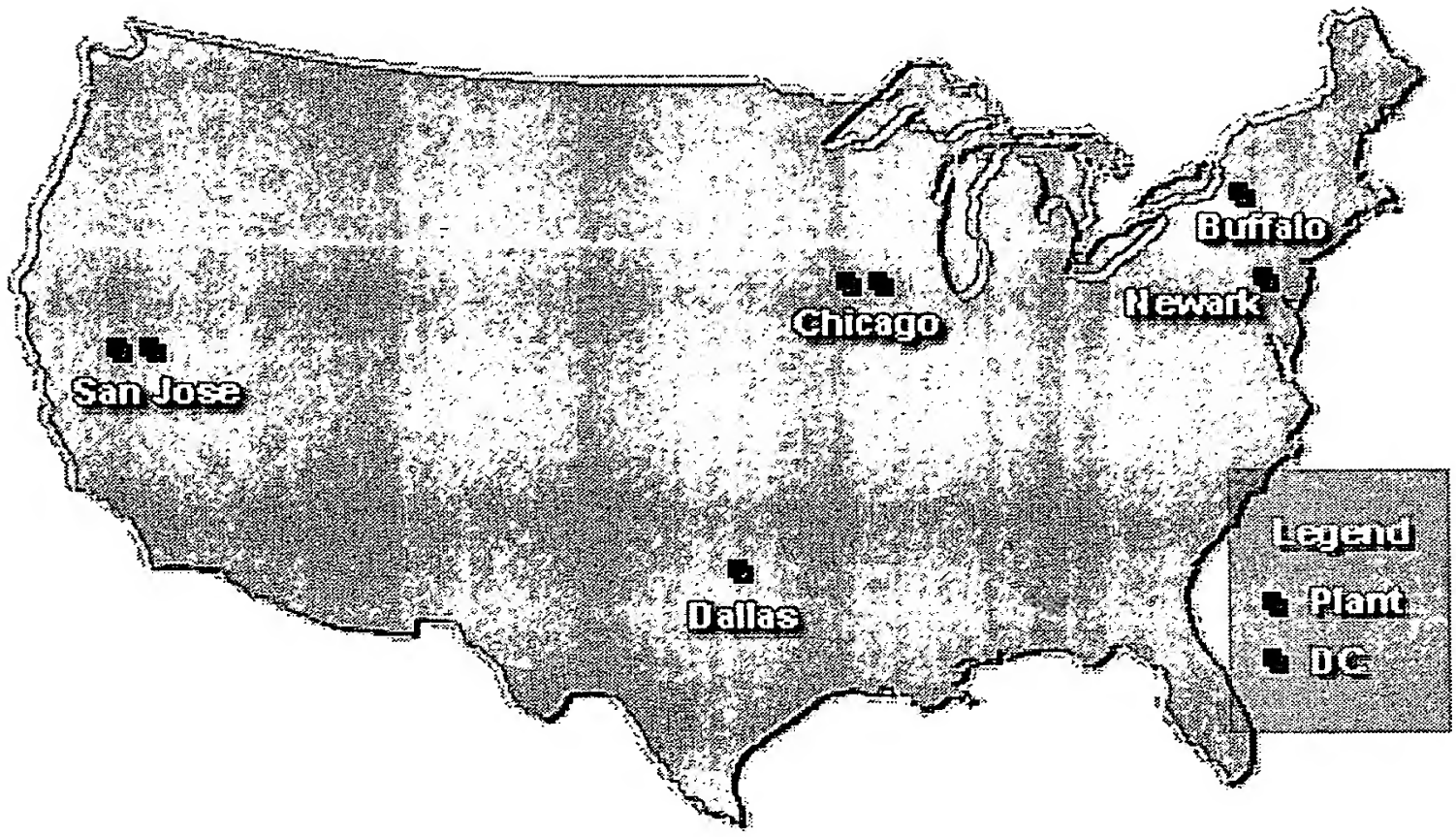
- Buffalo, New York (head quarters of Cereal, Inc.)
- Chicago, Illinois
- San Jose, California

In addition to these plants, the company has set up four distribution centers to service the United States. They are:

- Newark, New Jersey
- Chicago, Illinois (This is in conjunction with the production site.)
- Dallas, Texas
- San Jose, California (This is also in conjunction with the production site.)

Although this organization is limited to the United States, there are no product limitations that would make this solution infeasible for a worldwide corporation. (See Figure 5-1.)

Figure 5-1: Company Supply Chain



Within this supply chain, each production facility has its own raw material and packaging suppliers. See the Production and Distribution Facilities table below.

Table 5-1 Production and Distribution Facilities

Facility	Facility Type	Has Raw Material Supplier?	Has Packaging Supplier?	Sourced By	Distributor For	Comments
Buffalo	Production	Yes	Yes	N/A	N/A	
Chicago	Production	Yes	Yes	N/A	N/A	
San Jose	Production	Yes	Yes	N/A	N/A	
Newark	Distribution	No	No	Dallas	Eastern States	
Chicago	Distribution	No	No	Buffalo	Midwest	
Dallas	Distribution	No	Yes	Chicago	Southern States	Has a packaging supplier, used for special promotions where unique packaging is required.
San Jose	Distribution	No	No		West Coast	

Figure 5-2: Company Supply Chain Product Flow

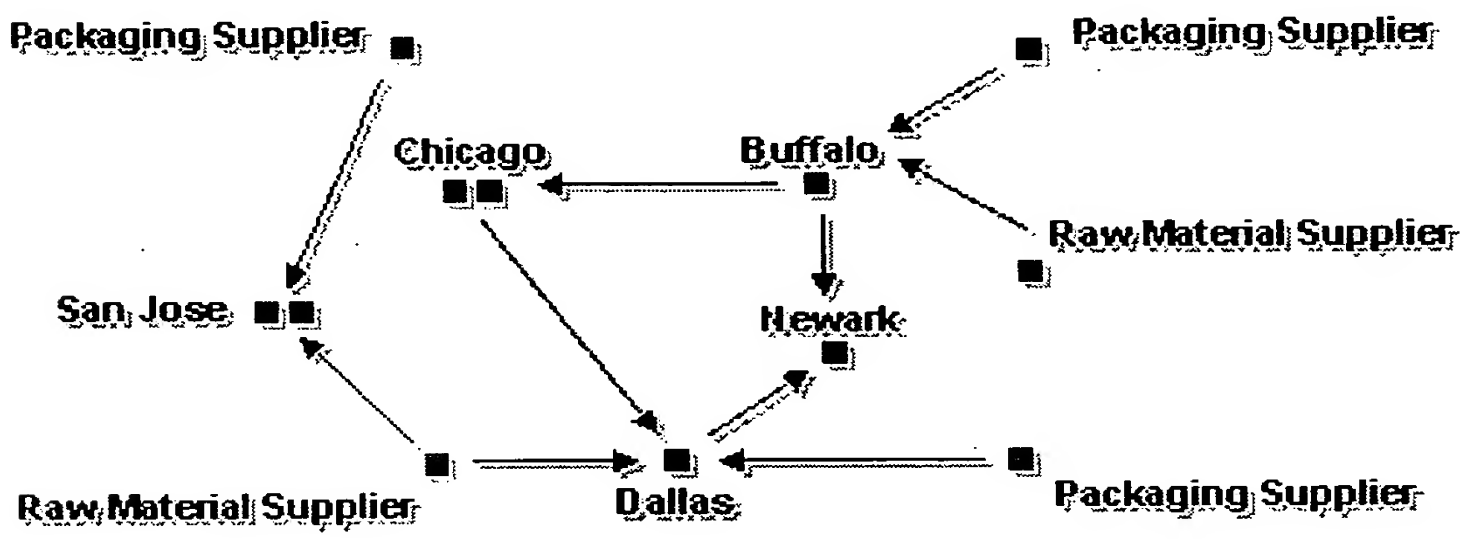
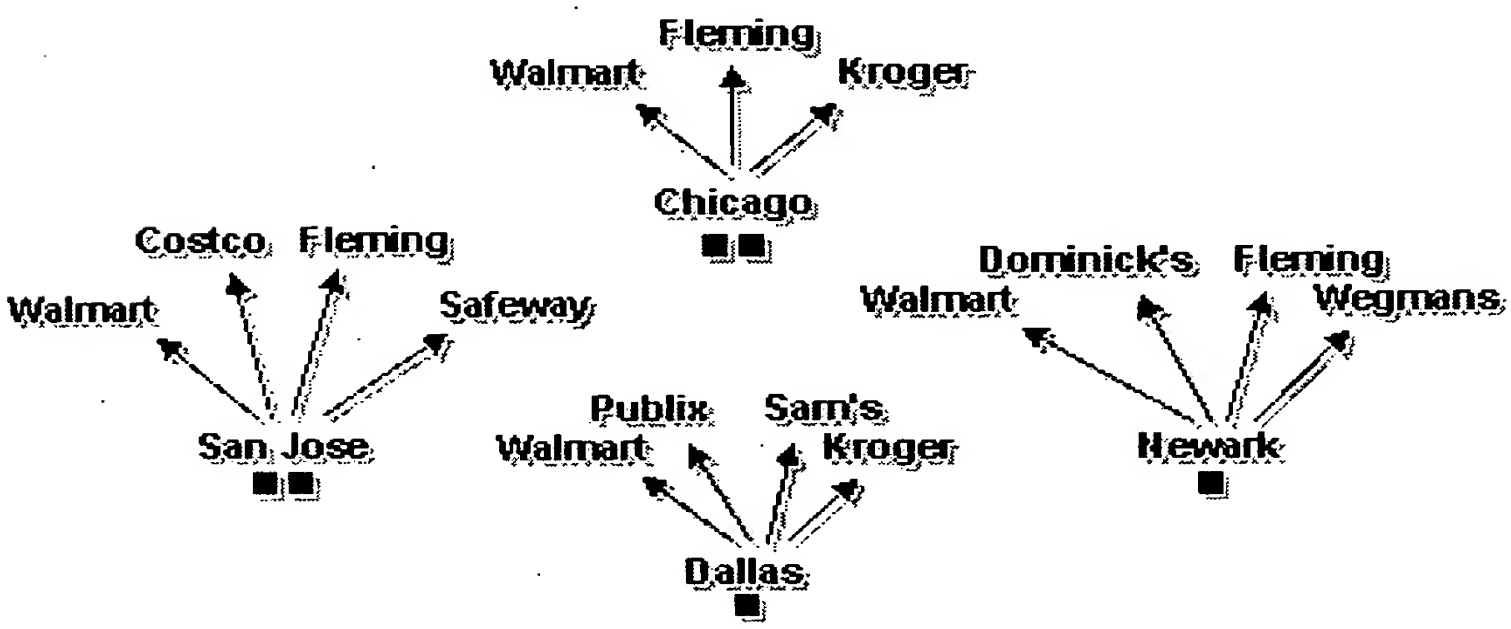


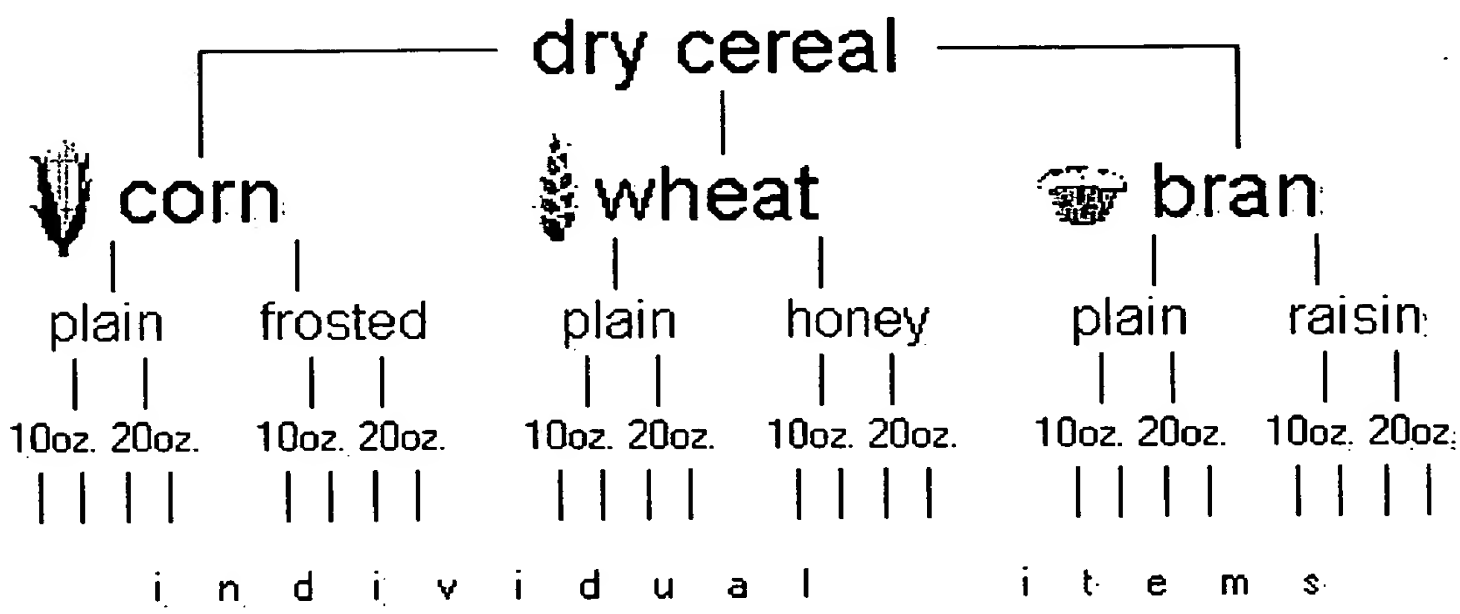
Figure 5-3: Ship To Locations

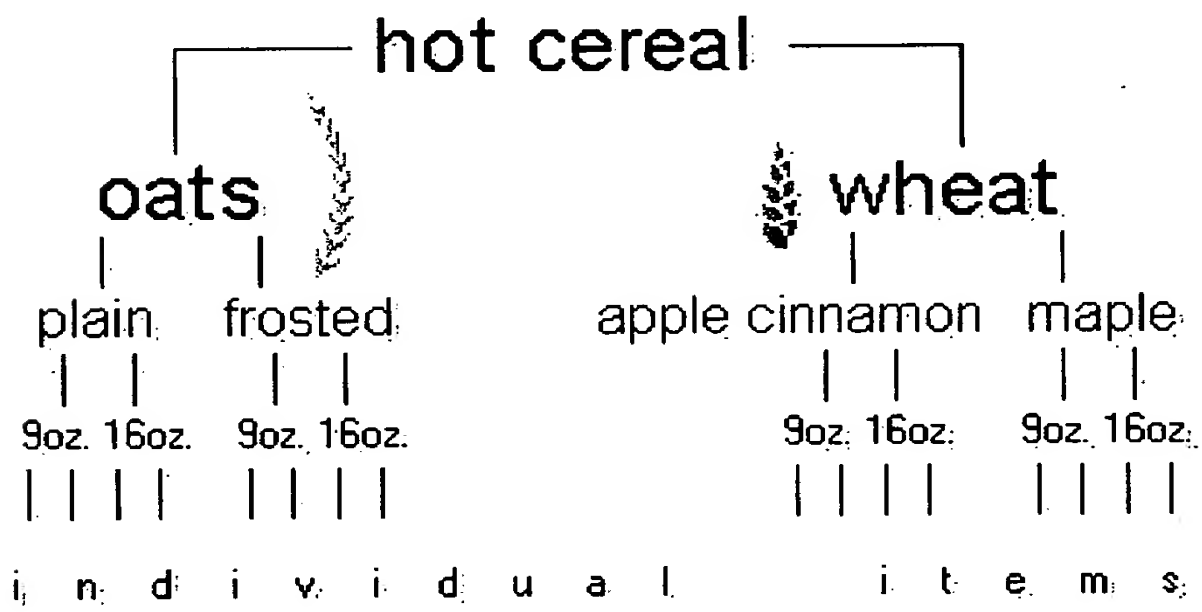


The Product Lines

Cereal allows Cereal Inc. to have one product line with seasonality (hot cereals) and one product line that is relatively non-seasonal (dry cereals). Cereal (both hot and dry) is manufactured from items such as corn, wheat, bran, and oats, with several flavor versions, such as frosted or honey. Cereal is sold in grocery stores in several sizes such as 10 ounce, 16 ounce, and 20 ounce boxes. Typically, hot cereal sells in greater quantities during the winter months (thus, the seasonality), whereas, dry cereals are sold impartially throughout the year.

The manufacturing process for cereal is generally make-pack. Cereal is a product with sufficiently fast turns and a long enough shelf life that shelf life planning is not a major issue. Cereal is sold to grocery stores and is often subject to promotions.

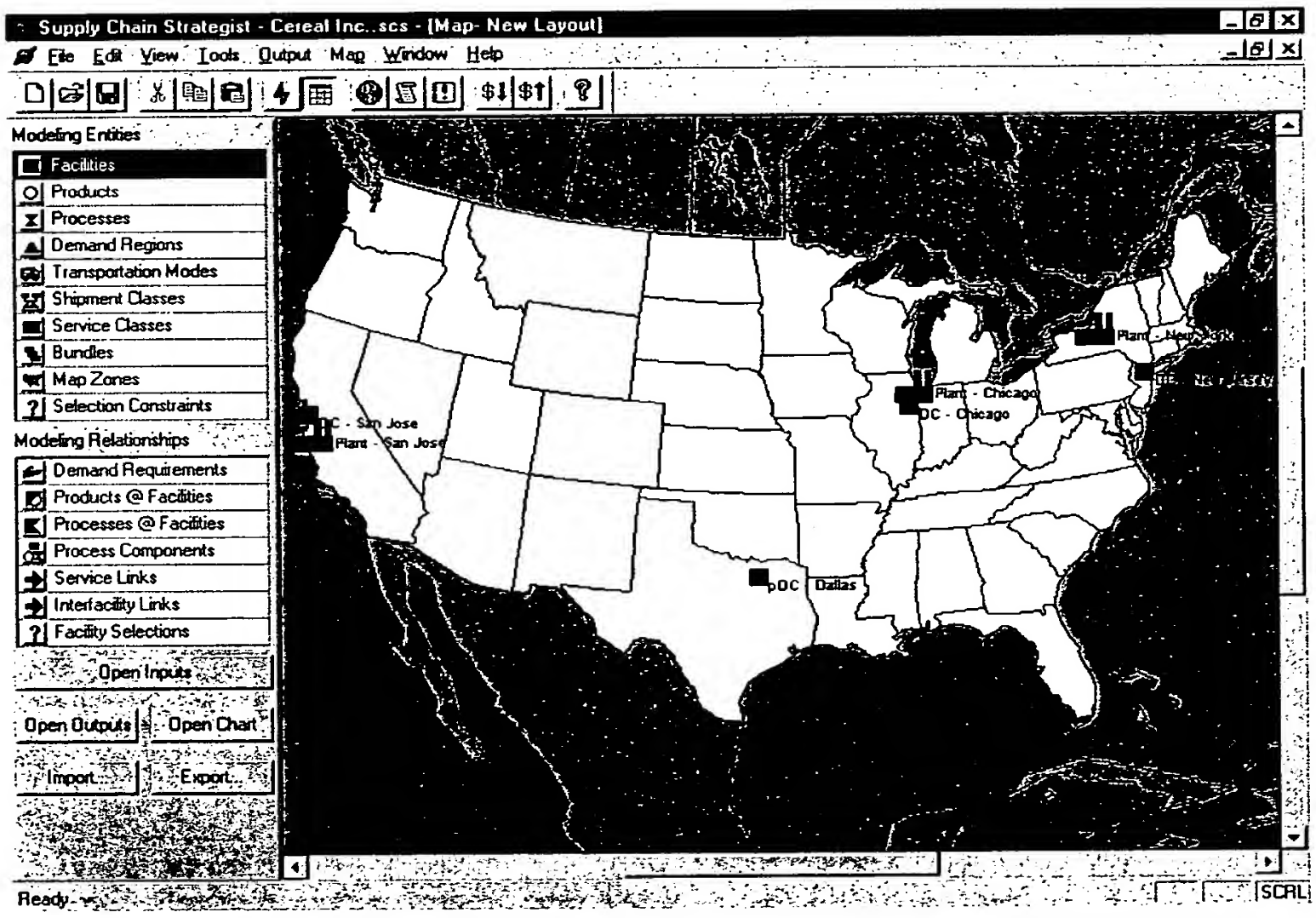

dry cereal
corn
wheat
bran
plain
frosted
plain
honey
plain
raisin
10oz. 20oz.
10oz. 20oz.
10oz. 20oz.
10oz. 20oz.
10oz. 20oz.
10oz. 20oz.
individual items


hot cereal
oats
wheat
plain
frosted
apple cinnamon
maple
9oz. 16oz.
9oz. 16oz.
9oz. 16oz.
9oz. 16oz.
individual items

Results of Optimization Runs – Benefits

Cereal Inc.'s strategic supply chain study resulted in annual supply chain savings of $87 million (10.6% of total supply chain costs). The analysis and implementation not only improved the bottom line, but also improved service times to the customers, preventing further market share erosion by the responsive marketplace.

Figure 5-2 Resulting Supply Chain



6. *Millions of Dollars*	*Original Network*	*New Network*	*Savings*	*Percent Contribution*
Raw Materials				
Raw	$ 486	$ 457	$ 29	33%
Packaging	$ 22	$ 21	$ 1	1%
Inbound Transportation	$ 127	$ 143	$ (16)	-18%
Production				
Facility Fixed	$ 46	$ 22	$ 24	28%
Cook / Coat / Mix	$ 7	$ 2	$ 5	6%
Package	$ 4	$ 2	$ 2	2%
Distribution				
Facility Fixed	$ -	$ 1	$ (1)	-1%
Handling	$ 20	$ 18	$ 2	2%
Storage/Inv. Carrying	$ 7	$ 7	$ -	0%
DC Replenishment	$ 49	$ 13	$ 36	41%
Delivery to Customer	$ 49	$ 44	$ 5	6%
TOTAL	$ 817	$ 730	$ 87	

Table 5-1: Costs of Before and After Supply Chains

Distribution center replenishment times are reduced.

By manufacturing multiple product lines at each remaining plant, the DC lead times have been drastically cut: from 2 days in the old network to 1.1 days in new network, a savings of 45%.

Customer delivery times are reduced.

By locating manufacturing and warehousing capacity closer to the market, all customers may now be served within their required service parameters. The old supply chain's delivery time requirements and the frequency with which they were previously met:

- DSD (2-day) 87%
- DSD (3-day) 78%
- Warehouse 97%

- Overall 90%

		Existing Network	New Network
DSD			
	1 Day	46%	50%
	2 Days	36%	43%
	3 Days	8%	7%
	4 Days	10%	0%
Warehouse			
	1 Day	62%	67%
	2 Days	35%	32%
	3 Days	0%	1%
	4 Days	3%	0%

Table 5-2: Percent of Deliveries within Specified Days

Postponement Strategy Potential Benefit

The proposed postponement strategy considers the holding plain cereal in inventory from 1-3 weeks, thus reducing the finished goods inventory by coating, mixing and packing closer to when demand hits. By holding plain cereal instead of committing early to a specific cereal flavor or packaging size, Cereal Inc. has the potential to save up to $3 million annually.

Improvement to Operating Profit

The recommended strategy will improve Cereal Inc.'s supply chain's contribution to operating profit by $85.2 million.

Millions of Dollars	Original Network	New Network	Contribution Improvement
Cash Expense	$ 787.4	$ 720.5	$ 66.9
Depreciation - Existing Assets	$ 28.8	$ 10.0	$ 18.8
Depreciation - New Assets	$ -	$ 0.5	$ (0.5)
Total	$ 816.2	$ 731.0	$ 85.2

Table 5-3: Contribution to Operating Profit

What About the Future? Keep Modeling...

This study is complete. The current strategy has been implemented. Tremendous savings and contribution are being realized. Is it time to put the strategic model away and focus wholly on the tactical and operational implementation of the strategy?

As all of us in the CPG marketplace know, the dynamic forces that control the marketplace, such as competitors activities, customers' demands & expectations, transportation rates, and new product development are continually changing. The most effective way to use the Supply Chain Strategist tool is on an on-going basis, continually looking to the future with rolling sales and demand forecasts, new manufacturing costs, and other data that reflect the projected, real-world business climate. At Cereal Co., we are committed to looking out 1-5 years and continually improving the supply chain.

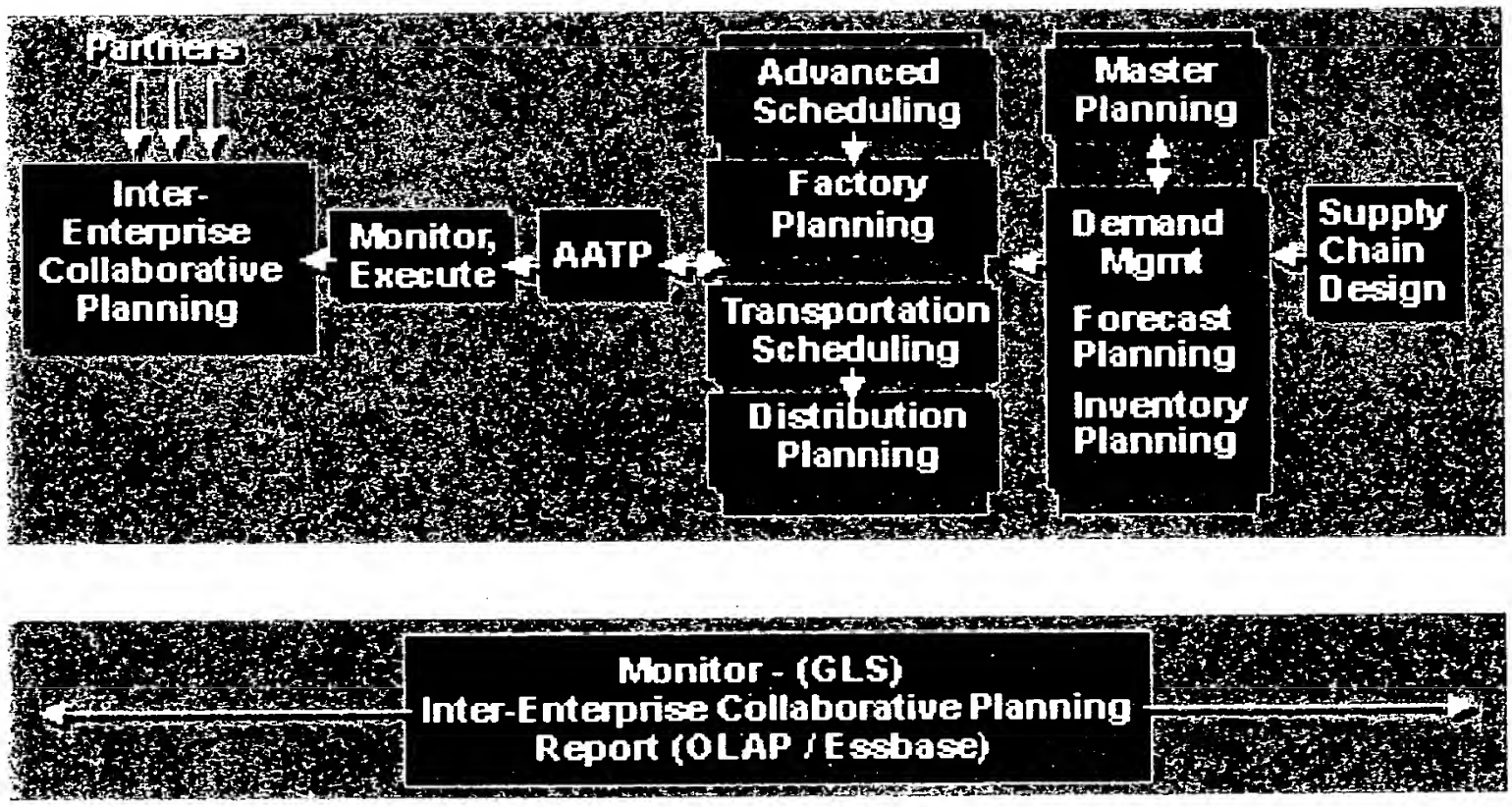
6. Rhythm Functional Solution

Distribution Centric Solution

Management of the supply chain occurs at three levels:

- Sales and Operations Planning which includes Master Planning, Demand Management, Forecast Planning, and Inventory Planning
- Supply Chain Planning which includes Advanced Scheduling, Factory Planner, Transportation Planning, and Distribution Planning
- Execution which includes Allocated ATP, Monitor and Execution, Inter-Enterprise Collaborative Planning

Figure 6-4: Distribution Centric Solution

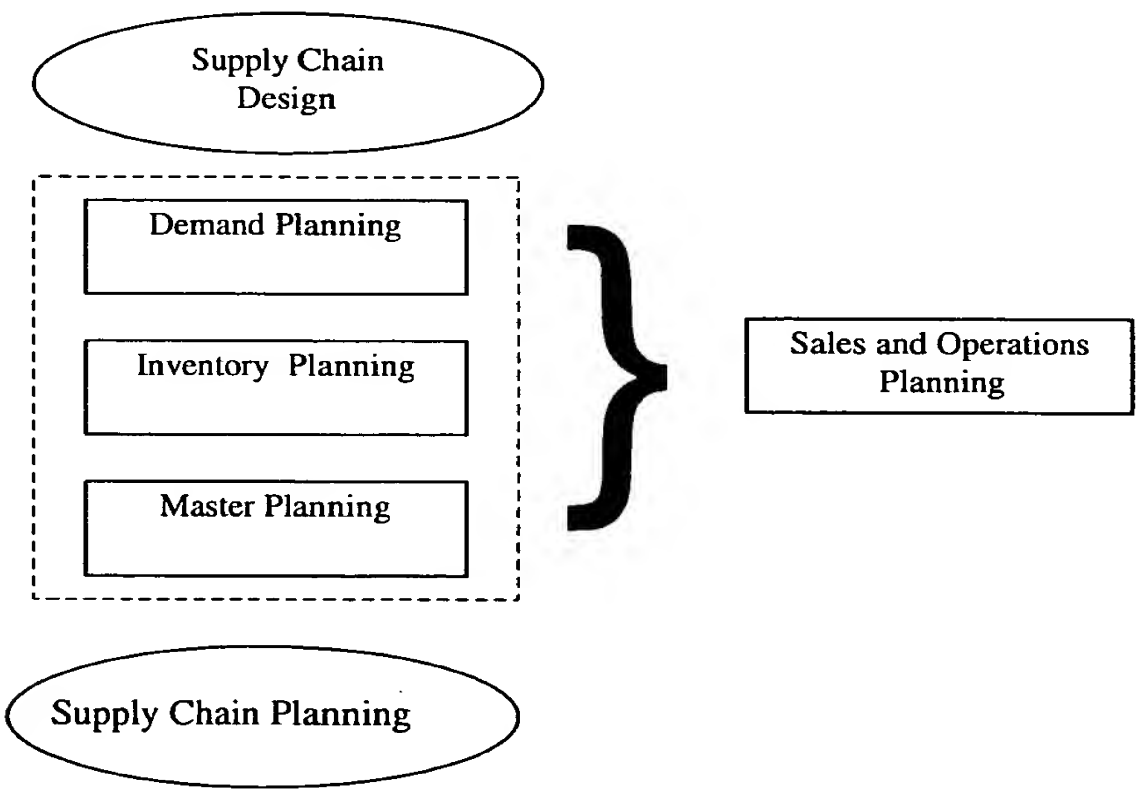


Sales and Operations Planning

Sales and Operations Planning is the process of translating an organization's goals into plans. Planning begins with an understanding of available resources and the current, planned, and alternative capabilities to meet customer needs.

Once Cereal Inc. has specified the resources in its supply chain design, it goes through the following three Sales and Operations Planning steps:

1. Demand Planning: the construction of a forecast reflecting the best estimates of future demand, including collaborating with customers on promotional plans.
2. Inventory Planning: deciding how much and where inventory should be stored within the supply chain to efficiently meet forecasted customer demand. In this case, efficiently means delivering a planned level of customer service at the lowest possible investment of working capital.
3. Master Planning: creating a time-phased plan for production and deployment of goods through the supply chain. The Master Plan specifies how the demand plan and the inventory plan will be met, given the available resources. It is the input to the day-to-day process of Supply Chain Planning.



Demand Planning

Why is the prediction of future demand important to a business?:

- Negotiation of long-term contracts.
- Advance warning of issues.
- Basis for short and long term planning of procurement, production, distribution and financial performance.

Cereal Inc. starts the demand planning process by preparing a baseline business forecast based on historical demand. Many different statistical techniques automatically evaluate accuracy. The most effective technique is used to generate the future baseline demand.

This baseline is then adjusted to reflect planned events such as phase-outs and roll-outs. Information and adjustments are entered from the field to include the latest market intelligence. Finally, promotion timing is adjusted to reflect current plans. The forecasting software automatically updates demand as promotion timing is moved. Again, built in formulas are used to adjust volume based on the combination of product, brand, category, geography, customer and other promotions.

During the inventory planning and master planning steps of sales and operations planning, planned events may be moved so that the final forecast reflects a demand plan that is feasible.

Inventory Planning

Cereal Inc. must store finished goods inventory at points within its supply chain to ensure that customer service goals are met. The amount stored and its location are automatically calculated by analyzing response capabilities and statistical variability. Specifically, levels are set for maximum and minimum inventories.

As the plan is carried out, production and deployment activities respect the inventory limits. This ensures attainment of customer service goals at the minimum possible investment of working capital.

Factors used in the calculation are as follows:

- Desired service level: set by plan at a variety of product, geography and customer combinations.
- Lead time and variability of supply: the faster and more reliable a product is supplied, the less inventory must be stored to meet demand.
- Quantity and variability of demand: the more variable the demand (within the lead time of supply), the more inventory is needed to meet customer needs.

Inventory planning enables Cereal Inc. to plan its investment in customer service and maximize the service for dollar invested.

Master Planning

Business issues addressed in this step are as follows:

- What should be made and shipped to where to meet demand?
- Is it feasible to meet demand given planned resources and standard routes? (i.e. Where will there be problems?)
- What alternatives are possible?
- What is the best alternative?

The demand plan and inventory plan are inputs to the master planning process. The master plan output is a high-level plan from four weeks to a year in the future. It is the input to the supply chain planning process focusing on detailed production and distribution plans starting from the order lead time horizon.

Transportation Optimization and Scheduling

The Transportation Optimizer provides Rhythm with the ability to include a cost "optimized" transportation plan. Using a combination of sophisticated solver algorithms and mixed integer programming, the Optimizer will produce a least cost transportation plan subject to real world constraints including such things as:

- Service requirements
- Historical carrier performance
- Origin and consignee hours of operation
- Required delivery times
- Equipment capacities
- Commodity rules

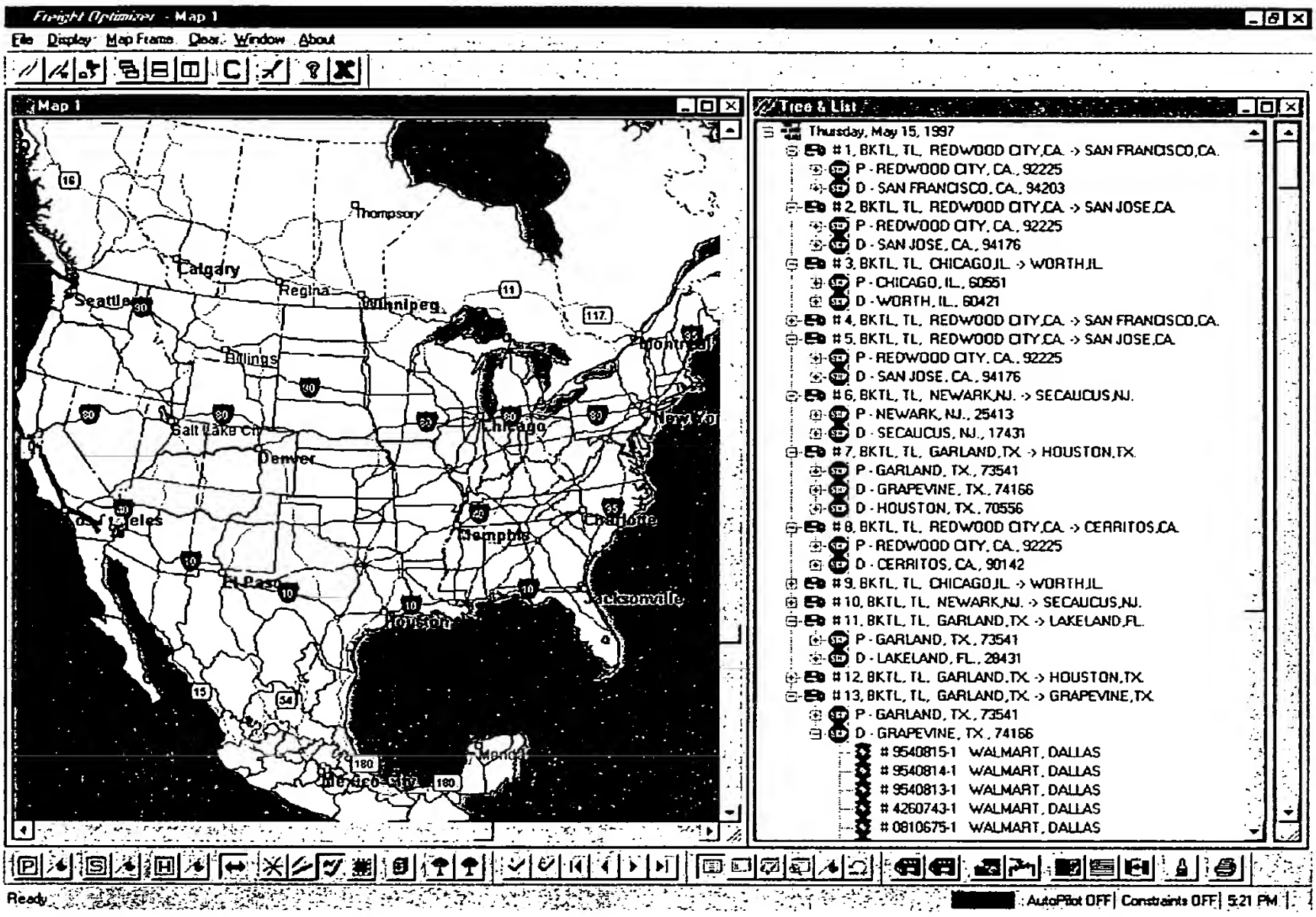
The key to the Optimizer is its ability to dynamically capitalize on numerous transportation network strategies in a limited amount of time yielding significantly improved transportation costs. Savings on transportation costs have reached 25% in some cases. Return on Investment (ROI) has been achieved in a few weeks. Using real world data, the Optimizer creates both direct and multi-leg consolidated loads across all modes of transit, dynamically using hub / cross-dock / pool points in a multi-pick, multi-drop environment. The Optimizer further provides the ability to capitalize on both backhaul and continuous movement opportunities. The end result is a lower pro-rated cost per shipment and consequently an overall lower cost of transportation.

Within an integrated environment, Rhythm has planned Cereal Inc.'s production resulting in quantities of items scheduled for various destination deliveries satisfying the supply chain's demand. The Transportation Optimizer sees these item quantities for load consolidation, routing and scheduling. See Figure 6-1. In determining these loads, the Optimizer works to:

- minimize the transportation costs associated with customer delivery routes
- maximize the use of equipment
- select the appropriate carriers
- ensure that delivery commitments are met

It also considers additional constraints including specific product requirements and product inclusion and exclusion rules. What results is an optimized shipping plan which is passed to Freight Management for execution.

Figure 6-1 Optimizer Map and Loads, Stops, and Shipments



In addition to its powerful solving capabilities, the Optimizer allows for your interactive planning in cooperation with its automated plan. Your changes are respected and incorporated by the automated planning function. Interactive planning suggestions are validated automatically against constraints. Upon completion of the optimized plan, the appropriate transportation data are made available to Rhythm.

In summary, operating interactively with Rhythm, the Optimizer provides an executable plan yielding lower costs, better carrier fleet utilization and ultimately better service. This is achieved via advanced consolidation and routing strategies even in a complex multi-echeloned distribution environment. The Optimizer has generated savings in transportation costs from 5-25% for typical implementations, with ROI measured in weeks rather than years.

The Optimizer has generated savings in transportation costs from 5-25% for typical implementations, with ROI measured in weeks rather than years.

Allocated Available-To-Promise

The first step in providing the capability to establish realistic delivery dates for customer orders is to determine what can be produced. Unlike traditional planning systems, Rhythm simultaneously generates plans based on the constantly changing dynamics of demand, material, and capacity while considering all constraints that will limit product flow throughout the supply chain. The result is a feasible, constraint-based plan that accurately reflects the expected output of the supply chain. This accurate plan can then be used to establish confident order promises.

Rhythm's Allocated Available-To-Promise functionality provides all the capabilities companies need to allocate product, make immediate and reliable delivery promises, and then to monitor those promises against the company's actual order fulfillment to identify opportunities for improved customer service.

Material Allocation: allocation is the process used to distribute material which is in short supply. (Source: APICS Dictionary; 8th Edition) Traditional ATP mechanisms establish delivery dates on a first-come, first-serve basis which severely limits a company's ability to improve customer service and profitability. By intelligently allocating product to specific market categories, a functionality that is unique to the Rhythm solution, companies can better serve high-priority customers, improve responsiveness to high-margin orders, and increase profitability.

Traditional ATP approaches are limited to "first-come, first-serve" (FCFS) commitments with no allocation capabilities. With FCFS delivery date promising, low-margin demand can consume all available and planned resources leaving nothing available for emergency orders or high-priority customers. This type of promising mechanism can result in missed opportunities to improve customer service, profitability, and sales function effectiveness. Intelligent allocation capabilities allow companies to capitalize on the following opportunities:

- Improve Customer Service: Emergency requests, particularly from high-priority customers, offer outstanding opportunities to provide exceptional service. But without the necessary functionality to reserve resources, this opportunity is lost.
- Improve Profitability: Emergency requests often allow companies to charge higher prices, as companies are willing to pay a premium for shorter-than-lead-time product delivery. Without this capability to reserve the required resources, the opportunity to maximize profits is also lost.

Improve Sales Function Effectiveness: Traditional ATP mechanisms also lack the ability to effectively manage the sales effort. Without visible consumption

status from sales activity, the sales function cannot make timely decisions regarding what is and is not selling. With this information, the sales function can more effectively focus its efforts: promoting certain items, or transferring product allocations form slow-moving regional areas to better-selling regional areas.

Companies with traditional ATP mechanisms can attempt to capitalize on these opportunities by rearranging orders and perhaps breaking previously made promises on lower-margin orders. These questionable actions, however, can have long-term, detrimental effects (i.e. lost customers). With no visibility and control over how products are sold, companies have no ability to serve high-priority customers, maximize profits, or increase return on assets.

Distribution Intensive companies generally fulfill customer orders from stocks. Rhythm's material allocation capability allows businesses to align their customer service goals to their market priorities. Assume that two of Cereal, Inc.'s clients have been set up to order product over the Internet. One is "Ma and Pa" Distribution which represents a small percentage of their sales volume and limited potential in the foreseeable future. The other customer is a major retailer: Fleming. The relationship is such that Fleming gets higher priority.

Through a web browser, "Ma and Pa" Distribution enters an order to Cereal, Inc. for two line items (Product A and Product B) with specific quantities and delivery dates. Rhythm responds back that the request for Product A can be satisfied as requested, but for Product B the exact requirements cannot be met. Rhythm gives two options:

- Less quantity in the time period requested
- Full requested quantity at a later delivery time

This response is given despite the fact that enough inventory is in stock to satisfy their original request. "Ma and Pa" Distribution accepts terms for Product A and decide to use the option of waiting for delivery of their Product B request.

Moments later, Fleming enters an order to Cereal, Inc. requesting Product B for a greater quantity than "Ma and Pa" Distribution, but request the same delivery date that was originally requested by "Ma and Pa" Distribution. However, Rhythm's ATP function can honor this request even though the order was received after "Ma and Pa's" request. Being able to allocate material aligned to the customer service goals of the company ensures that high profit, high volume, high potential customer's service levels are maintained. They are never jeopardized due to first-come, first-serve mechanisms.

Plan Monitoring and Execution

Rhythm develops a plan that is optimized to operational efficiency for the overall supply chain, not in isolation of one component from another. Rhythm takes a top down analysis of the entire supply network, harnessing the data flow within the network for optimal throughput. As with Cereal, Inc., the network is comprised of many different players:

- suppliers
- freight forwarders
- transport companies
- distribution centers
- airlines
- shipping companies
- customs and excise

All of them have information concerning the progress of an order and associated inventory through the supply chain. They use their own information systems to control their particular piece of the operation. Rhythm enables companies to have an overall management capability of these disparate operations, but there is still a need to share progress information to monitor the plan's execution.

The Global Logistics System (GLS) is a control and command system that is entirely focused on providing information required for effective management of the total supply network. It is a proactive, monitoring tool for day to day management of the network taking into consideration the dynamic nature of logistics activities. This provides visibility to "real time" information about what is happening to orders and inventory at every point in the supply chain. Messages are received from the outside world triggering events which, in turn, track movement along the supply chain reflecting actual status. However, based on the scheduled dates of events from the Rhythm Distribution Intensive solution, if a certain event does not occur within a specified time, warning messages are generated to notify individuals that there may be a potential disruption in the supply chain. Early warning helps to manage these situations proactively to take effective actions to correct the problem.

Unplanned Delay Within A Supplier's Manufacturing Site

Cereal, Inc.'s Dallas site purchases paperboard units from their Packaging Supplier which are specially printed for a promotion. The Global Logistics System has modeled the supplier's operations for monitoring. The supplier's cutting machine is unavailable resulting in a four day delay in satisfying the demand. GLS triggers an alarm that the cutting operation has not started on schedule. Upon discovering that there will be a delay, Rhythm has determined that this will result in a delivery of the packaging materials to Dallas four days late. However, working with the packaging supplier, it has been determined that by working overtime once the cutting machine becomes available, and by

expediting delivery via a different routing, the impact of the machine breakdown can be minimized to two days. Cereal, Inc. can now revise its operation plans using the new delivery date and plan proactively for expediting methods to meet the original schedule.

Outbound Shipment Delay

Cereal, Inc. is scheduled to deliver a shipment from its Dallas Distribution Center directly to a customer's Distribution Center. Cereal, Inc.'s execution systems have indicated that the shipment is still sitting in the staging area two hours after it should have been loaded onto the truck. GLS triggers a warning message to the Customer Support Representative (CSR) that the outbound shipment has been delayed. With this early warning, the CSR has time to investigate the problem and determine alternatives for problem resolution through "what-if" scenarios within Rhythm. Inter-Enterprise Collaborative Planning architecture routes the "alert condition" to the customer site on a delayed basis. Once the message is sent, the CSR can proactively call the customer acknowledging the situation and providing alternatives to correct the problem. Instead of after the fact reaction, GLS provides a proactive, early warning allowing time to effectively plan options, both for Cereal, Inc. and the customer.

Inbound Shipment Delay

Cereal, Inc. relies on its suppliers to deliver product on-time, as do all companies. Late deliveries of raw materials result in rippling effects throughout the supply chain. Rhythm plans expected delivery times that GLS monitors. An alarm is set off when GLS determines that a receipt from a packaging supplier has not been received. Once again, early warning provides the capability to investigate the causes of the problem so appropriate alternatives can be investigated. If it is determined that the resulting condition is due to a hard constraint, then Cereal, Inc. can use Rhythm to replan and reoptimize to synchronize the plan.

GLS provides the supply chain manager with the information and decision support tools necessary to improve customer service, reduce inventory and logistics costs.

Co-Managed Inventory

Kroger owns a warehouse in Dallas which is co-managed by Cereal, Inc. The retailer at this Kroger site does not have the technology to integrate his internet linked PC to the ERP systems at Kroger corporate which contain the information on inventory levels and demand. At the Dallas Kroger site, the inventory clerk receives an update from a warehouse worker that a roof leak is the cause of damaged finished goods from last night's storm. An inspection and physical inventory count indicates that there are only 2000 units in stock rather than the 12000 units that were believed to be in stock.

The inventory clerk launches the Web browser to pull up an update screen to reflect the physical count of the inventory. By using a pull-down menu, the clerk selects the item and manually enters the recently counted inventory level. This information is sent to Cereal, Inc. by simply pressing the "send" button.

By virtue of the Inter-Enterprise Collaborative Planning architecture, Cereal, Inc. has a model of this DC in its supply chain model. Rhythm accepts the data and immediately recalculates the DC's inventory position, indicating that a stockout condition will occur in two weeks. This information is routed back to the UI on the inventory clerk's PC. Since customer service is Kroger's primary concern, the inventory clerk simply presses the "solve" button. This action triggers Rhythm to develop a revised replenishment plan for the Kroger DC based on its stocking policies as predetermined in the model. Inter-Enterprise Collaborative Planning then routes that information back to the inventory clerk's PC.

Key benefits of co-managed inventory are the following :

- Rhythm Inter-Enterprise Collaborative Planning architecture provides connection within the supply chain across various technology platforms, no matter how minimal the technology capabilities of the players. Effective co-management must enable two-way communication between the parties, but preserve the technology investments of all involved.
- Rhythm provides more than just a data exchange, such as EDI solutions. EDI solutions are uni-directional. These solutions have, at best, delayed feedback loops and are open to multiple resolution iterations. Rhythm Inter-Enterprise Collaborative Planning architecture allows the co-managed site to be directly modeled with their company policies - more than just data. This enables Rhythm to co-manage to the customer's preferred rules. It eliminates the iterative guesswork of policy comprise.

Forecast Collaboration

Sales and Operations Planning (SOP) is a process that provides management the ability to strategically direct its businesses to achieve competitive advantage on a continuous basis. It does this by integrating customer-focused marketing plans for new and existing products with the management of the supply chain. The process brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans. It is performed at least once a month and is reviewed by management at an aggregate level. The process must reconcile all supply, demand, and new-product plans at both the detail and aggregate level and tie it to the business plan. It is the definitive statement of the company's plans for the near to intermediate term covering a horizon sufficient to plan for resources and support the annual business planning process. Executed properly, the sales and operation planning process links the strategic plans for the business with its execution and reviews performance measures for continuous improvement. A section of this process is a "negotiation" that attempts to determine the expected demand over the planning horizons. Those involved use formal forecasting systems, extrinsic factors and indicators, and "gut-level" experience to establish the forecasted demand level.

Collaborative applications are an application of the SOP process to the supply chain. The logic is that external players, linked to the value chain, have valuable information that will help in establishing a coordinated supply chain plan. Collaborative Forecasting is one of these applications.

Initially, a retailer and the manufacturer will set up collaboration metrics and parameters for various products in an unconstrained forecasting phase. Using Inter-Enterprise Collaborative Planning architecture, these metrics/parameters are shared information supporting the collaboration process. For example, date effective demand tolerance percentages could be established for the forecast horizon. These filters may allow only a 2% fluctuation in forecasted demand within one week of the horizon start date, but would find a 10% variance acceptable one month out.

Business Problem

The manufacturer wants to launch a major promotion for a cereal product which is to take place 6 weeks from now. The promotion is expected to last for two weeks. The retailer and the manufacturer will go through a forecast collaboration process which will result in a singular forecast which drives Rhythm's planning systems. The manufacturer provides the retailer with a constrained supply profile and an agreed to price point. They agree to a singular demand forecast for this product. For many products, over 50% of volume moved through a store is sold on deal. These deals are challenging to forecast and create a saw tooth pattern in demand that can often cause an out of stock. Complicating matters, retailers can change the terms of a deal within a moments notice. The issue is how effectively can manufacturer's respond to these changes so that customer service levels

remain high. When customer service levels are high, the sales force is that much more effective at "selling-in" the next deal, and the customers do not even consider discontinuing a SKU due to cut orders.

Collaboration Process

The manufacturer enters the collaboration process by selecting the option Unconstrained Collaboration and choosing the Demand Alignment selection in the Demand Management Business Process. The manufacturer's sales representative clicks on the wizard which launches the automatic business process driven workflow. The first step "Receive Messages" is highlighted. The Rhythm solution embeds the Microsoft Wizard approach to business processes and best business practices as an integral part of the software. Its key benefit is that it provides "quick starts" for initial users as well as the foundation for continuous learning and propagating best practices across organizations, thus achieving faster ROI through more intuitive implementations.

Resolution Window

The manufacturer clicks on the next/forward button and the process step "View messages/problem window/resolution window" is highlighted. The user selects the radio button option which shows the resolution window. The window displays history of all the forecasts which have been solved, either automatically or through a number of iterations which is provided to the user. Rhythm provides for engine to engine intelligent resolution of forecast differences. Due to intelligence provided to the system, a number of misaligned forecasts can be resolved automatically. One to many collaboration is possible between retailers and suppliers through a single interface, so context can be maintained to all collaborations.

Analyze Forecast and Consumption

The manufacturer's sales representative clicks on the problem tab and selects the problem for the promotional product from the retailer and brings up the details of his forecast. The process step "analyze forecast" is highlighted. The forecast is capable of being decomposed into elements, due to the multidimensional analysis tool, such as base line, seasonality, trend line, promotional lift, competitor's counter-lift and human override to enable much more precise identification of dichotomies and corrections. The manufacturer increases the demand for the SKU, by increasing the promotion line of the forecast for weeks 6 and 7. Though the user changed the forecast interactively, the process of forecast modification can be dynamically linked with a forecast tool such as Rhythm Forecast Planner, which would feed the revised forecast automatically in the collaborative process. The manufacturer's sales representative creates a note to his retailer counterpart that gives the rationale for the new forecast with a high priority status. The manufacturer clicks on the administrator option from the top menu options and selects the Initiate Collaboration option. This step automatically initiates collaboration and sends all messages.

The retailer clicks on the "wizard" and executes the step to receive messages. The retailer clicks on the forward button which goes to next step "View messages/problems/resolution window" and checks the messages window to pull up the message regarding the promotion from the manufacturer. The retailer selects the message and brings up the forecast which has not cleared the business metrics and parameters. The retailer clicks on the problem and brings up the screen which shows his forecast and the manufacturer's forecast. Specific filters are used to determine the significant differences which require human resolution. Filters can be very flexible. They can be equations, modelets, percentage based, and variances in units. They can be mixed and matched. The retailer clicks on the forward button and advances the process step to "analyze forecast".

Demand Volume Increases

The retailer observes that the specific forecast elements (forecasted quantities within specific time periods) which did not clear the filter have been highlighted in red. These are the demand volume increases expected from the product promotion. These forecasts are displayed graphically also, showing the differences between the retailer and the manufacturer. The retailer agrees with the promotional elements of the forecast specified by the manufacturer and changes their forecast data interactively in the same time periods since the price policy is still valid. This results in the red highlights disappearing from the promotional elements - the forecast is inside the filter limits. The retailer then sends a message that states, "We are in agreement with your promotional forecast element figures."

The manufacturer once again launches the "wizard" to receive messages. It accepts and synchronizes all the inbound queues/messages, runs the forecast alignment step, and looks in the message window. There is a message from the retailer regarding the forecast indicating that agreement has been met.

Bigger Promotion

Three weeks later, the retailer has decided to do a bigger promotion for the same product during the same time frame. Actually, it was decided to do a buy-one / get-one free (bogo) expansion of the promotion. Over the phone, the retailer apologizes for the short notice, but he has already run the ad in the paper and really needs this to happen. (And it started out to be such a nice day!) The manufacturer first enters these new causal factors in Rhythm Forecasting which determines the additional uplift in demand. With a shorter than normal lead time, fulfillment is a concern, and customer service levels must remain high for the retailer. The real question is, "Is the inventory available?"

The sales representative calls the materials planner who checks availability in relation to the revised forecast levels. Shortages exist but the planner checks Rhythm for alternative sourcing options and reallocation possibilities. The planner is able to resolve the shortages and runs the new demand through the

Supply Chain Planner. The results for the new constrained supply profile is generated. The results are shown and communicated to the Retailer.

7. Acronyms

Acronym	Description
AATP	Allocated ATP
ATP	Available To Promise
CMR	Customer Managed Replenishment
CPG	Consumer Packaged Goods
CRP	Continuous Replenishment Programs
CSR	Customer Support Representative
DC	Distribution Center
DRP	Distribution Requirements Planning
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
FM	Freight Management
FO	Freight Optimizer
FP	Factory Planner
GLS	Global Logistics System
JIT	Just-In-Time
OLAP	On-Line Analytical Processing
QR	Quick Response
ROI	Return On Investment
SCP	Supply Chain Planner
SCS	Supply Chain Strategist
SKU	Stock Keeping Units
SOP	Sales and Operations Planning
TOC	Theory Of Constraints
UI	User Interface
VMI	Vendor Managed Inventory
VMR	Vendor Managed Replenishment

